HYGIENE

ELEMENTARY COURSE

ADAPTED TO THE SYLLABUS OF THE
SOUTH KENSINGTON SCIENCE DEPARTMENT

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PREFACE.

THIS manual on Hygiene, or the Science of Health, has been prepared to meet the requirements of the Syllabus for the Elementary Stage of that subject issued by the Science Department. Hygiene, but recently recognised by the Department, is a subject of the highest importance, as dealing with matters affecting the well-being of the individual and of the nation.

The sections and divisions of the work coincide pretty closely with the arrangement laid down in that Syllabus, though some of the topics have been amplified much beyond the limits therein prescribed. No effort has been spared to make the book comprehensive and clear; and the compiler trusts that students will find all the information they need in studying Hygiene in its first stage, and also stated in a way they can easily understand. Section I. is treated at some length because it seems to lay the foundation for very much that follows.

The compiler has not relied on his own knowledge of the matters treated on, but has consulted very many authorities. He would caution students against taking quantities and proportions of analyses too strictly, as in this respect the divergence is great on all sides.

The syllabus of the Elementary Stage will be found in the Appendix, also the Department's questions set at the first examination on the subject in May 1884, together with some additional questions selected from those set by the Society of Arts in recent years.

A glossary of such terms as are not explained in the text is also added, which it is hoped may prove useful.

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HYGIENE.

ELEMENTARY COURSE.

DEFINITION.

1. **Hygiene**—a word derived from the Greek *hygieia*, health—is the science of health. It treats of all matters relating to the physical and mental well-being of human creatures, such as the food they eat, the water they drink, the air they breathe, the clothing they wear, the homes in which they live, their personal habits, the diseases and accidents to which they are liable, and the influences exerted upon them by locality, occupation, custom, &c. It aims at securing bodily and mental vigour, and at preserving the powers of both body and mind to old age.*

2. Of the importance of this science there can be no question, and from very early times learned men like Hippocrates and Galen have sought not only to cure

* The late Dr Parkes defines it thus: 'Hygiene is the art of preserving health; that is, of obtaining the most perfect action of body and mind during as long a period as is consistent with the laws of life. In other words, it aims at rendering growth more perfect, decay less rapid, life more vigorous, and death more remote.'

disease, but to embody rules or 'laws of health' by the practice of which disease should be prevented and life prolonged.

But of late years this subject has grown into a science (based chiefly on the science of Physiology), and is attracting more attention every day by its manifest importance and success in promoting the health and consequent increased happiness of individuals and of communities. Various bodies, notably the Society of Arts, have striven to bring Hygiene and its kindred subjects prominently before the people during the last twenty years, and now the Science and Art Department at South Kensington has given it a recognised place in the educational work of the nation. The syllabus issued by the Department will be our guide in dealing with the subject in the following pages.

SECTION I.

FOOD, DIET, AND COOKING.

FOOD.

3. **Its Uses.**—Physiology teaches us that the human body is a complex structure composed of about twenty different materials. In the immature individual some substances must be supplied for *growth*, while in all persons, whether young or old, *wear* and *tear* of tissue are going on at all times, and consequently fresh material is constantly needed to repair the loss thus occasioned.

But besides this, oxidation of carbon, or real combustion, is going on in the lungs (chiefly) for the purpose of generating animal heat and force. Thus for *growth*, *repair*, and *combustion*, food is indispensable. In the widest sense of the term, food is anything that supplies

the body with material for its use, and so would include *air* and *water*, but it is generally the practice to restrict the appellation 'food' to those substances which are capable of what is termed oxidation, or which furnish nutriment to the tissues and glands, thus leaving air and water to be considered separately. As nearly the whole of the actively living tissue is made up of the four important elements, carbon, nitrogen, hydrogen, and oxygen, it follows that food substances which are employed for the nourishment and support of living bodies must consist *chiefly* of those elements, though other simple bodies, such, for instance, as sulphur, are also used in constructive work.

4. **Its Classification.**—Taking as our ground of classification the work of food in the body, we may divide it into three classes—first, *Nitrogenous*, or tissue-forming; second, *Non-nitrogenous* (commonly called *Carbonaceous*), or heat-forming; third, *Mineral*, or that which largely forms the hard parts of the body, and supplies necessary chemical salts to the glands.

5. **Nitrogenous Food.**—This is so called because the *characteristic* element in the substances arranged under this head is *Nitrogen*, which they possess in addition to carbon, oxygen, and hydrogen; the proportion of nitrogen to carbon being about two parts to seven. These nitrogenous compounds are often spoken of as albuminoids or albuminates, because they are all nearly identical in chemical composition with albumen, the main solid constituent of white of egg. The other members of the class beside albumen are *fibrin*, *syntonin*, *myosin*, *globulin*, and *casein*, from the animal kingdom; and *gluten* and *legumin*, from the vegetable kingdom. Besides these true albuminates there are four substances, *gelatin*, *ossein*, *chondrin*, and *keratin*, which only under

particular circumstances are nutrients, and of which it is said by a well-known writer on the subject, 'we cannot affirm that they are true flesh-formers.'

6. **Non-nitrogenous or Carbonaceous Food.**—These, as their name implies, are substances containing no nitrogen, but are made up of *carbon*, *hydrogen*, and *oxygen*, the first being the *characteristic* element. They are all capable of oxidation, and their function is chiefly to generate animal heat and force by combustion in the lungs and tissues. Carbonaceous food may be divided into (*a*) *carbo-hydrates*—namely, starch and the various kinds of sugar; (*b*) *hydro-carbons*, or fats; (*c*) *vegetable acids*, such as *malic*, *citric*, &c. The *carbo-hydrates* are so called because they contain just sufficient oxygen in them to form, with the hydrogen present, water. In the *hydro-carbons* the amount of oxygen is less than sufficient to convert all the hydrogen present into water. In the *vegetable acids* the oxygen is generally greater in amount than is needed to form water.

7. **Mineral Food.**—This food is necessary for the structure of bone, and the supply of mineral salts to the blood and to the fluids which aid in digestion. The chief mineral substances contained in our food are chloride of sodium (common salt), potassium-chloride, phosphate of lime, carbonate of lime, phosphate of magnesia, fluorine, and iron.

NATURE OF NITROGENOUS FOODS.

8. **Albumen**, as we have before said, is the main constituent of white of egg. It is also found to the extent of 7 per cent. in blood, 5 per cent. in substance of brain, and 2 per cent. in muscle. Its appearance is that of a yellowish transparent gum-like mass which is soluble in cold water. Its most characteristic

property is that of coagulating (or clotting) on the application of heat, beginning at 60° C. (140 F.). Alcohol also coagulates and hardens it, as do also ether and creosote. It is the most easily digested of all the flesh-formers, especially when raw. In 100 parts of pure dry albumen are found: carbon, 53·5; hydrogen, 7; nitrogen, 15·5; oxygen, 22; phosphorus, ·4; and sulphur, 1·6. The presence of this last makes itself known by the blackening of a silver spoon when left in an egg.

9. **Fibrin.**—This substance separates from the blood in a solid state soon after it has left the body. It may be readily obtained by stirring blood with twigs, to which after some minutes a white stringy substance is found adhering. Fibrin is a grayish-white, stringy, elastic, and tasteless solid, insoluble in water, and nearly identical in composition with albumen, from which it differs mainly in being spontaneously coagulable. It forms about 15 per cent. of beef muscle (free from fat), and is the most largely used of all flesh-forming foods.

10. **Gluten** is really vegetable fibrin. Beccari, an Italian chemist, struck by the similarity of the odour of gluten when burning or decomposing to that of fibrin, was led to examine its composition, and found it to be identical with fibrin. It forms 10 to 12 per cent. of wheat grain, and may easily be obtained from wheat flour by washing the flour in water, when the gluten, being insoluble in water, remains as a grayish, sticky, bird-limy substance.

11. **Syntonin** and **Myosin** are albuminoids much resembling fibrin. The latter is the living juice of muscle, which by coagulation after death produces death-stiffening (*rigor mortis*). **Globulin,** which exists chiefly in the blood, and forms the largest constituent

of the red blood-corpuscles, also closely resembles fibrin.

12. **Casein** is the albuminous substance contained in milk and cheese. It is distinguished from other albuminoids by the ease with which weak acids coagulate it. Cow's milk contains about 4 per cent. of it; and human milk 1·6 per cent. If milk be allowed to stand freely exposed to the air, or if there be added to fresh milk an acid liquid called essence of rennet (made by placing a piece of the stomach of a calf in water), the milk will separate into two parts, (1) a firm white flaky deposit called *curd*, and (2) a thin liquid called *whey*. The firmer and denser part of the curd is *casein*, which in coagulation has caught in its fibres a part of the other solid substances present in the milk. Cheddar cheese contains 28 per cent. of it; Cheshire, 39 per cent.; while cheeses made of skimmed milk, that is, milk from which the cream has been taken, contain as much as 45 per cent. Casein is less easy of digestion than the other albuminoids, but it is the most concentrated form of flesh-forming food.

13. **Legumin** may be termed vegetable casein. It is so called because it occurs most largely in the order of plants called Leguminosæ (*legume*, Latin for pod), such as the pea, bean, lentil, &c., and makes these seeds of great dietetic value, especially as the vegetable legumin, when properly cooked, is more easy of digestion than its animal counterpart casein.

14. The above are all *true* flesh-formers, but the following four, which form a sub-group of doubtful nutrients, contain more nitrogen and less carbon than true albuminoids, and are also less easy of digestion.

Ossein is that constituent of bone to which its strength and elasticity are due. If a bone be placed

in a solution of hydrochloric acid and water (1 part HCl to 9 water), all the earthy matter contained in the bone will after some time be dissolved out. The elastic mass which is left, retaining the shape of the original bone, is nearly all ossein. When ossein is subjected to the boiling-point of water (212° F., or 100° C.), or, better still, to the heat of steam, it is readily converted into **gelatin,** which forms so large a part of connective tissue; and, indeed, the gelatin of commerce is chiefly made by boiling cuttings of skin, calves' feet, tendons, &c. If cartilage be boiled, it yields the substance **chondrin** (from Gr. *chondros*, cartilage), which contains less nitrogen and more water than gelatin. **Keratin** is a horny substance obtained from elastic tissue, epidermis, hair, hoofs, &c., and is of very small value as a nutrient, if any.

NATURE OF NON-NITROGENOUS OR CARBONACEOUS FOODS.

15. The most important substance among the heat-givers is **starch.** It is found largely in the cereal plants, rice, maize, wheat, &c.; also in the fruits, roots, tubers, stems, &c. of many other plants. It occurs in the form of granules, having characteristic markings on the cell-wall, so that one kind of starch can easily be distinguished from another by microscopical examination. Seen free, it appears as a white glistening powder, commonly termed farina. It is insoluble in cold water, alcohol, and ether, a fact which has an important bearing on its use and preparation. Starch, as we have before said, is a carbo-hydrate; its chemical symbol is $C_6H_{10}O_5$, and thus a molecule of starch consists of carbon, hydrogen, and oxygen, in the proportion of 6 atoms of carbon to 5 atoms of water

(H_2O). Exposed to a heat of 60° C. (140° F.), it begins to change; the starch granule swells up when thus heated (with water), the cell-wall ruptures and produces the well-known condition of 'paste' so much used for stiffening linen. If heated to 200° C. (392° F.) by itself (dry), it undergoes a very remarkable change, forming a transparent solid, perfectly soluble in water, called dextrin or British gum. It is to this form that the starch taken as food must be reduced in the process of digestion before it can find its way into the blood capillaries through the walls of the alimentary canal; and this change is brought about by the active principles in the saliva (ptyalin) and in the pancreatic juice (pancreatin). Starch is the most abundant product of the vegetable kingdom next to wood, and forms the most commonly used heat-forming food.

The percentage of starch in various articles of diet may be seen from the following table:

Arrowroot	83	Scotch oatmeal	65
Rice	80	Peas	55
Pearl barley	76	Haricot beans	49
Millet	74	Potatoes	23
Fine wheaten flour	74	Carrots	8
Maize	65	Vegetable marrow	·5

Note.—These numbers vary in various tables according to the quality of the respective articles examined.

16. **Sugar.**—While starch is the commonest and the most widely distributed of carbonaceous foods, sugar is the *readiest*, though they are practically equal in nutritive power. Sugar is exceedingly soluble in water, three parts of sugar dissolving in one part of cold water. Because of its solubility it is very readily absorbed by the mucous membrane lining the alimentary canal,

and thus it soon finds its way, after being eaten, into the blood system.

Sugar exists under several forms, but the most abundant and best known is that of **sucrose** or cane-sugar. It is the expressed juice of the sugar-cane rendered granular by boiling. Being brought to this country under the name of Muscavado or raw sugar, it is refined by being dissolved in lime water and mixed with animal charcoal and blood serum. When carefully heated, the albumen present in the serum coagulates and rises to the surface, bringing with it all solid impurities. These are skimmed off, and the liquid is afterwards filtered through twilled cotton, and again through a layer of animal charcoal, in order to remove the natural colouring matter. The sirup is then agitated by wooden oars till it granulates, when it is poured into moulds to form sugar-loaves. That part of the juice which does not form crystals, but remains a thick fluid, is called treacle, molasses, or golden-sirup, and, although very sweet, is less pure than sugar. The whiter and harder the loaf-sugar, the better is its quality, and the less the quantity of water it holds. The coarse brown sugars hold as much as 10 per cent. of water, while the best refined sugar has only ·25 per cent. Unrefined sugars are liable to ferment, and often contain *acari* or sugar mites and microscopic fungi.

17. A great deal of sugar now used in Europe is made from the sugar-beet (*Beta vulgaris*). Many other grasses besides the sugar-cane contain large proportions of sugar, while another source is the sugar-maple, the sap of which in Canada and the United States is collected and boiled down. **Grape-sugar**, or **glucose**, is also abundantly distributed throughout the vegetable kingdom. It is much less sweet and is also less soluble in water than

cane-sugar. It bears several names; for example, that variety found in ripe sweet fruits is called *dextrose*, that which is present largely in honey receives the name of *lævulose*, while that which occurs in malt is called *maltose*.

Milk-sugar, or **lactose**, is another form of sugar having the composition of cane-sugar, but with many of the properties of grape-sugar. It is one of the constituents of all milks, but it has comparatively little sweetness, and is much less soluble than the previously mentioned sugars. Cow's milk contains about 4 or 5 per cent. of lactose.

18. **Fats or Hydro-carbons.**—Under this head are included the various forms of solid fat, oil or liquid fat, and butter, which may be termed milk-fat. The fats supply the most *condensed* form of carbonaceous food. All natural oils and fats are compounds of glycerine with certain acids, the chief compounds being *olein*, *stearin*, and *palmatin*. **Olein** is a colourless liquid, solidifying at the freezing-point of water (32° F., or 0° C.). Olive-oil is a good example of olein. **Stearin** is the most abundant of the solid constituents of fats, and the hardness of mutton suet is due to its presence. **Palmatin** receives its name from palm-oil, in which it is abundantly present; and it forms the chief solid constituent of butter, as *olein* is its chief fluid one. Fats and oils may be heated to about 260° C. (468° F.) without undergoing much change; but heated above that point, they give off a powerfully smelling substance as vapour, called acrolein.

The fat best known and most esteemed is **butter.** This, in newly drawn milk, appears as little oily globules floating in the liquid, which, on the milk remaining still, rise as cream. The average amount of milk-fat in

the cream of cow's milk is about 36 per cent. Churning makes cream to form a solid—butter, which to be of good quality should contain about 88 per cent. of milk-fat.

Many oils are obtained from the vegetable world, some, like olive-oil already mentioned, being used as a direct food, others reach the body through various articles of diet; for example, all those seeds which bear the name of nuts are rich in oil, as may be seen by their burning so easily with a flame. Indulgence in these fruits is apt to derange the digestion and to produce great nausea, owing to the nature and amount of the vegetable oils present.

19. **Vegetable Acids.**—Under this head we arrange *oxalic*, *tartaric*, *citric*, *malic*, and *acetic* acids. They are nearly all conveyed to the body in the various fruits eaten by man, and their main use is to 'preserve the alkalinity of the blood by being converted into carbonates' (Parkes), and in this way they contribute much to health. They do not furnish much nutriment, energy, or animal heat.

MINERAL FOODS.

20. These and their uses have already been mentioned, but we may further say that common salt is needed to the extent of 250 grains per day for the production of the hydrochloric acid of gastric juice, and the salts present in bile (taurocholate and glycolate of soda), also for general health purposes.

Potassium salts are also found in muscle juice (ozmazome), in milk, and in the blood, and their absence or small supply is said to be a common cause of skin and other diseases. They enter the body by such articles of diet as fresh vegetables, fruits, and bread, especially

that made from whole wheat-meal. Phosphate of lime and carbonate of lime are necessary for the growth of bone, and such food as contains them is essential to the young. The best way to get this mineral matter is through milk—a deficiency of its supply, and a want of assimilation when it is supplied, being the chief causes of rickets.

A little iron, variously stated at from 40 to 150 grains, is found in the blood of an adult, and is absolutely needed for health. Many persons, especially young women, show the want of it by their pallid countenances and weak body.

21. The necessity of a *mixed diet* is clearly seen from a consideration of the various uses of food. An animal cannot live for any length of time on flesh-forming food alone, or on heat-forming food only. It must have *water* to help in the solution and distribution of other foods, *nitrogenous food* to repair and build up all the tissues, *carbonaceous food* to generate heat and to form fat, and *mineral substances* to make bone, &c.

ANIMAL FOOD.

22. We have already spoken of some materials (*proximate principles*, as they are called in physiology) which are found in the animal kingdom, such as fibrin. We now proceed to discuss the *articles* of food derived from that kingdom. The class consists of the flesh of animals, their eggs, their milk, and butter and cheese made from their milk.

23. **Butcher-meat.**—Under this name are usually classed *beef*, *mutton*, *pork*, *veal*, and *lamb*. **Beef** is the most largely consumed, and, weight for weight, contains more nutritive matter than any of the other members of the class. Much, however, depends on its age and the

manner in which it has been fed. The flesh of a three-year-old grass-fed ox is much more nutritive and relishable than that of a stall-fed animal of eighteen months, rapidly fattened for market on spiced foods. Much of the beef sent to market is the flesh of cows that, after ceasing to give milk, have been fattened for the knife. This flesh is not so tender or nourishing as ox or heifer beef.

Mutton contains proportionately more fat than beef, but the lean is considered somewhat more digestible. It is therefore often recommended for invalids or persons of sedentary habits.

Veal contains proportionately more water, rather more albuminoids, and much less fat than beef. It is often killed in such a way as to drain the flesh of its blood, and thus it loses much of its nutritive value. Being deficient in carbonaceous material, it is usually eaten with ham or bacon.

Lamb is more delicate in tissue, and more watery than mutton. It is a light wholesome food, but on account of its great shrinkage in cooking, and the quickness of its digestibility, it is far from being an economical article of diet.

Pork differs from all the foregoing, in containing more fat, and that chiefly olein, and also in its muscular fibre being compact and dense. This renders it much more indigestible than beef and mutton. While good roasted beef is digested in three hours, roast pork takes upwards of five hours. It is also liable to more rapid decomposition, especially in hot weather. The use of pork may be allowed for farm-labourers and others employed in the open air; but it favours illnesses in persons of confined occupation or sedentary habits, and should be abstained from by all who suffer from

skin disease, or from an impure state of the blood. As regards certain forms of disease, Jews and Mohammedans are much more free from them than nations who eat the flesh of the pig. Pickled pork and also bacon are more digestible than fresh pork. The process of curing has the effect of largely decreasing the quantity of water in it, and, as some think, of making the muscular fibre more tender. Mild breakfast bacon is to some constitutions a very useful article of diet, being moderately digestible, and supplying heat-forming material in a pleasant form.

24. The **viscera** or internal parts of animals, called by butchers the offal, is much used for food, especially by the poor. Such food is much more liable to be diseased than the muscular flesh, and always requires careful cleaning and thorough cooking. But it is generally more digestible, and contains more nitrogenous matter than muscle. *Tripe* contains about 10 per cent. of fat, and as much nitrogenous material, all the rest being water. It digests in one hour. *Sweetbread* should be the 'thymus'* gland of the ox or lamb, but the *pancreas* bears the same name. This is considered a delicacy, and is digestible.

As may be seen from the following analysis, *calves' liver* is rich in nitrogenous food, but is deficient in fat.

Water	72·3	in 100 parts.
Nitrogenous matter	20·1	"
Fat, &c.	6·1	"
Mineral matter	1·5	"

It therefore requires that starchy or fatty foods should be eaten with it, as in the familiar dish 'calves'

* The thymus gland is situated at the base of the heart behind the sternum, and is only found in young animals.

liver and bacon.' Liver, when sound, is therefore seen to be a cheap, nutritious food.

The *heart* and *kidneys* are composed of dense tissue, and while highly nitrogenous articles of food, cannot be considered digestible.

25. **Fish.**—This forms a large source of animal food, and it is well that increased attention has of late been given to its supply for the use of our great population. The flesh of fish contains, as all muscular fibre does, *albumen*, *fibrin*, and *gelatin*, though in less proportions than the flesh of land animals, as water predominates in fish; for example, in sole there is no less a quantity than 13¾ oz. out of 1 lb. One substance, phosphorus (not free, but combined as some phosphate), highly essential to brain and nerve tissue, is found in fish more largely than in butcher-meat.

Fishes may be divided for purposes of diet into two classes: 1. Those whose fat or oily matter is stored up in the liver, and whose flesh is white and somewhat dry. This class includes the whiting, cod, haddock, sole, turbot, plaice, &c. Their flesh consists of about 22 per cent. solid matter, of which at least 18 per cent. is nitrogenous matter. In order to increase its nutritive value, it is necessary to supplement it with butter, oily sauces, &c. 2. Those whose fat or oily matter is fairly diffused throughout the muscular portion. This class includes the salmon and sturgeon, whose flesh is of a darker colour and denser texture, as well as the mackerel, sprat, pilchard, herring, and eel—the last having no less than 23 per cent. of fat in its composition. On account of the abundance of fat, the fishes of this class, though really more nutritious and satisfying, are more difficult of digestion to persons of weakly constitution.

The fresher the fish the more digestible it is, and when the flesh is firm, fish meat is in its highest condition. Much fish is preserved in several ways for after use—by salting, drying, smoking, pickling, or by the use of oil. Herrings known as 'bloaters' and 'kippers,' anchovies, pilchards, sardines, and salmon are familiar examples. Great quantities of fish, chiefly salmon and lobster, now come to this country already cooked and preserved in tins from British Columbia, Canada, &c., and form a considerable addition to our food-supply. If the tin has not been quite air-tight, there is danger in this kind of food, and even when perfectly good, it should be eaten at once after opening.

Some sorts of shell-fish are very digestible, notably the oyster (when eaten raw); others are less so. When cooked, the nitrogenous matter of the oyster and mussel is rendered tough and insoluble.

The lobster is rich in phosphates, but its flesh is of close texture, and, being a gross eater of carrion, the use of lobster flesh is sometimes attended with danger. Crabs should be cleansed with the greatest care before being eaten, and these, too, being coarse feeders, often disagree even with healthy persons.

26. **Game.**—Animals which have had much freedom of life, seem to elaborate in their muscular tissue most albumen, and consequently more phosphorus than those domesticated by man. At the same time the flesh is more fibrous and sinewy, and consequently tougher, and needs keeping longer in order to make it tender. This is particularly true of those animals known as 'game.' **Venison**, the flesh of deer, is a food resembling mutton, but much more rich in nitrogen, and which, when kept till the muscular tissue is partly disintegrated, is very digestible. **The Hare** has a strong, rich flesh,

which, when sufficiently tender and nicely cooked, forms a relishable and nutritious dish, though delicate stomachs find it too rich. **The Wild Rabbit** has a much more delicate flesh than the hare; the flesh contains little fat, and is a popular food, capable of being served in many ways. When in season, this animal is consumed in our large towns most extensively. The flesh of the *tame rabbit* is somewhat insipid and watery, and is far less nutritious than that of the wild variety.

Birds form an important contingent in our food-supply. Over thirty kinds are used for food in this country alone. The flesh of the various *wild* birds used as food, such as the pheasant, partridge, pigeon, ptarmigan, wild duck, &c., is nutritious and easily digested, if kept a few days before being cooked. In the flesh of the common fowl, fibrin is the characteristic substance, fat being present in small quantity; and when young, this food is tender and nutritious. The flesh of the *duck* and *goose* is much darker, closer, stronger, and more savoury than that of the fowl. The fat is somewhat indigestible, as also is the stuffing commonly used, consisting of sage and onions.

27. **Eggs.**—These are a valuable contribution to our dietary. They are rich in the simplest form of nitrogenous food, namely, albumen, and contain a fair amount of fat. The mineral matter, though small in quantity, is rich in quality, consisting as it does of phosphates of lime, potash, soda, magnesia, and iron.

The analysis of a fresh hen's egg is as follows:

Water	71·7	per cent.
Albuminoids	14·0	"
Oil and fat	11·0	"
Membranes	2·0	"
Mineral matter	1·3	"

Eggs contain, therefore, about as much flesh-forming and heat-giving substances as an equal weight of butcher-meat. They differ in flavour according to the kind of bird and its food, so that a duck's or goose's egg is stronger than a fowl's egg. The egg of a barn-door fowl is far sweeter than that of a poorly fed fowl; and that of a bird feeding on fish is strong and not very agreeable. The egg of the turkey is good and rich, and that of the plover has a very delicate flavour.

28. **Milk** is the model food; that is, it furnishes all the nutrients required by the body, and in their due proportion. In addition to its 5 per cent. of carbonaceous material, such as butter and lactose, it contains 4 per cent. of casein, a nitrogenous food, and a small yet sufficient quantity of mineral matter. The milk of the cow is that chiefly used in this country. Its average composition is as follows:

Water	86·3	per cent.
Casein	4·1	"
Milk-fat	3·7	"
Lactose	5·1	"
Mineral matter	·8	"
	100·0	

It differs from human milk in having a greater amount of casein and less sugar. Thus, when it is used for the food of young children, it should be diluted by having nearly half a pint of water added to a pint of milk, and should be also sweetened by the addition of $1\frac{1}{2}$ oz. of sugar to the same quantity. Cow's milk differs much in quality according to the time of year, the age and food of the animal, its breed, &c., but as will be seen from the above table, it should have about 13·7 per cent. of solid matter in it. Such milk will be nearly opaque,

having a slight straw colour increasing to a brighter yellow as the animal gets more green food, a soft, slightly sweet taste, and a faint animal odour when warm and fresh. It is to the presence of fat globules suspended in the more watery part that milk owes its opacity. These rise in the milk as cream, which is skimmed off, thus depriving the milk of most of its fat and about one-sixth of its casein.

As has been previously stated, the peculiar property of casein as an albuminoid is, that it so readily coagulates on the application of a weak acid. If skimmed milk stands, there is soon, especially in hot weather, produced a change, namely, that of turning sour, in which process lactic acid is formed from the lactose, and the casein coagulating, and catching the remaining milk-fat and some of the mineral matter, forms a curd which floats in the serum of milk termed whey. It is usual in cheese-making, however, to form the curd while the milk is fresh by adding a little rennet to the milk. The whey containing the sugar, and some of the albumen and salts, is strained away, and the curd is pressed into a mould to form the cheese. This is a highly concentrated article of flesh-forming food, difficult of digestion by most persons when new and tough, but moderately digestible when about twelve months old. It is a valuable and economical article of diet to our agricultural labourers and other outdoor workers,* but the consumption of it is small by our manufacturing operatives and persons of sedentary habits. The late Dr Lankester stated that a small amount of old cheese probably helps

* While 1 lb. of beef contains 1 oz. 122 grs. of flesh-forming material, 1 lb. of double Gloucester cheese contains no less than 4 oz. 294 grs.; that is, nearly four times as much in the cheese as in the beef, and only costing the same.

in the digestion of other foods. When toasted, all cheese is highly indigestible.

Buttermilk, the residue from the making of butter, is a very nutritious article, containing everything in the milk except the fat and a small part of the casein. It would be well if it were used as an article of food for the poor in country places much more than it is, instead of being so often wasted or given to pigs. It forms a useful diet for invalids who are not able to digest fat, and for children suffering from wasting diseases. Potatoes supplemented by buttermilk, make a dish that supplies the needed carbonaceous and nitrogenous foods to the body in far better proportion than potatoes do alone.

NITROGENOUS FOODS FROM THE VEGETABLE WORLD.

29. As before mentioned, there is found in plants an exact counterpart to fibrin as to composition—namely, gluten. This is chiefly found in the seeds of the cereal plants, hence the very great importance attached to bread, especially in countries in the temperate zone. In England, bread is now almost exclusively made of **wheaten** flour, though formerly black bread made of rye or barley was extensively used by the poor. Good wheaten flour is now much more easily obtained than formerly. It should be white, dry, and have a sweet smell free from 'must.' The percentage of gluten present should be about 8. Some of the very white flours are so because they contain an overplus of starch and a corresponding loss of gluten, therefore for poor working-people that live so largely on bread, seconds flour is better than that known as 'biscuit.' Brown bread made from whole wheat-meal is more nutritious than white, but is less digestible. There is more gluten

in it, more fat, and also there are phosphates present which are nearly or entirely absent from white flour. The bran of whole wheat bread, however fine it may be ground, irritates the lining of the stomach and intestines of delicate persons, and brown bread should therefore be avoided by such; while for persons having a tendency to chronic constipation, its use at one meal per day (at least) will be found beneficial.

Macaroni and vermicelli are nearly all pure gluten (hardened) obtained from the rich Italian wheats; so is semolina, an article of diet prepared in a granulated form from wheat grown in Italy, North Africa, and elsewhere.

30. **Oatmeal** contains so little gluten that it cannot be fermented and made into bread. Yet it possesses a large quantity of other nitrogenous matter and much fat. It is eaten in Scotland and the north of England either as oatcake or as porridge. The quality of oatmeal varies very much, Scotch oatmeal being the best and richest; it forms a very nourishing though somewhat laxative food. The porridge should be well cooked, otherwise it may produce a rash on the skin. It is generally eaten with treacle or milk. Being rich in mineral matter, it forms an important food for the young who need to make bone.

31. **Barley** meal is not now used in this country for the purpose of making bread, but the grain is subjected to a rasping process by which the outer fibrous and coarser coats are completely removed, and a round pellet-like body is produced called pearl barley, which is used for thickening soups and hashes, and for making puddings. Barley flour is much inferior to wheaten flour in flesh-formers.

Rye flour is sometimes used, either pure or mixed

with wheaten flour, to make a *fancy* bread in this country, but it is more largely used in the countries of Northern Europe, and is there called *black* bread. It is dark coloured, heavy, and slightly sour.

TABLE OF THE ENGLISH CEREALS.

PERCENTAGE PROPORTIONS FOUND IN EACH.*

	Wheaten Flour.	Oatmeal.	Pearl Barley.	Rye Flour.
Water	13·0	5·0	14·6	13·0
Albuminoids	10·5	16·1	6·2	10·5
Starch	74·3	63·0	76·0	71·0
Fat	·8	10·1	1·3	1·6
Woody tissue	·7	3·7	·8	2·3
Mineral matter	·7	2·1	1·1	1·6
	100·0	100·0	100·0	100·0

32. A comparison of these quantities shows that oatmeal is rich in flesh-forming material, has a large excess of *fat* over the other cereals, thus supplying the body with a ready heat-forming material, and is also richer in bone-making material than any other of the cereals. The objection to its use lies in the large amount of woody tissue present in it, but this difficulty is obviated by its being ground fine and very well cooked.

33. **Pulse.**—We have before stated that the seeds of all the plants in the order Leguminosæ are rich in albuminoids, especially that form termed legumin, which is really vegetable casein. Pulse (the generic name given to the seeds of these plants) differs, then, from the grain of cereals, in having a far higher proportion of flesh-formers, and therefore beans, peas, lentils, &c, should

* Compiled from Church on *Food*.

be eaten with foods rich in starch, sugar, and fat. The legumin occurs both in the unripe parts and in the ripe seed. Hence we use the young pod of kidney and other beans as well as the ripened seeds. Legumin seems to be more soluble and more easily digested in the unripe fresh seeds than when they have become hard and dry; for example, green peas are easily digested even raw, but dry ripe peas require long and slow cooking to render them fit for use. They constitute a valuable food, however, when properly cooked in the form of pease-pudding and pea-soup. In the form of pea-flour they can be advantageously used to thicken soups and hashes. Large quantities of peas are grown in England or imported for human food, but their use is often accompanied by flatulence and colic in delicate stomachs.

Beans.—Beside the pods of unripe French, dwarf, and other beans, we use the unripe seeds of the broad or Windsor bean, and the dry, ripe haricot bean. The former is, when young, an agreeable and wholesome food, especially to outdoor workers, and is mostly eaten with pickled pork, bacon, &c. The **haricot bean**, imported from Germany, Holland, &c., is now much more largely used than formerly, and deservedly so, as it is, when carefully soaked and thoroughly cooked, a most nutritious form of food, containing 23 per cent. casein and 52·3 per cent. starch, as well as a fair amount of fat and mineral matter.

Lentils.—These are largely grown in Southern Europe and Egypt, and their use has much increased lately in this country. Stripped of its fibrous covering, the lentil is very nutritious. Lentil flour can be used like pea-flour, and the preparations sold under the name of Revalenta Arabica, Ervalenta, &c., for medicinal

purposes, are largely composed of it. The chemical composition of lentils is much the same as that of haricot beans.

34. **Other Cereals grown in Foreign Countries.**—**Rice** is a cereal more largely grown and more largely consumed than any other in the world, forming, as it does, the chief food of tropical races, and also appearing in various forms on the tables of the people of temperate climes. It contains more starch than any other of its class, but it is deficient in flesh-forming and mineral matter. Its starch is very pure and easily digestible, and so forms a good food for young people especially, but it is most useful when eaten along with substances rich in nitrogenous matter, for example, milk.

Maize or Indian corn, so largely used in the United States, and greatly imported into this country, contains much fat and a peculiar kind of fibrin, specially named maize-fibrin, which requires very careful cooking to make it digestible. Maize flour is often used as an adulterant of wheaten flour, compared with which it is poorer in flesh-formers, though in that respect it is richer than rice. Maizena is a fine, granulated preparation of maize (called polenta in Italy), of which puddings, cakes, mush (a kind of porridge), &c. are made. **Hominy** is the broken or split maize, and is essentially a *starchy* food.

Millet is the seed of several grass-like plants growing in various parts of the world. It is used as human food chiefly in hot countries. It can be made into bread very similar in chemical composition to wheaten bread. **Dourra** or **Dari**, used in North Africa, and derived from certain species of grasses (*Sorghum*), is a white grain larger than millet, but of very similar composition and nutritive value.

TABLE OF THE FOREIGN CEREALS.

PERCENTAGE PROPORTIONS FOUND IN EACH.*

	Rice.	Maize.	Millet.	Dourra.
Water	14·6	14·5	13·0	12·2
Albuminoids	7·5	9·0	15·3	8·2
Starch	76·0	64·5	61·6	70·6
Fat	·5	5·0	5·0	4·2
Woody tissue	·9	5·0	3·5	3·1
Mineral matter	·5	2·0	1·6	1·7
	100·0	100·0	100·0	100·0

NON-NITROGENOUS FOODS FROM THE VEGETABLE WORLD.

35. **Starchy Foods.**—It will be seen from the foregoing tables, that while the cereals contain a fair proportion of albuminoids or flesh-forming materials, yet that the chief bulk of their substance is starch, the carbonaceous or heat-forming element. This is notably the case with rice, in which there is ten times as much starch as albuminoids. There are some foods, however, which may be more truly termed starchy, inasmuch as they contain little other nutritive material than starch.

Arrowroot is obtained chiefly from the rhizome (the underground stem) of *Maranta arundinacea*, a flag-like plant growing in the West Indies and Bermuda Islands. Good arrowroot should be perfectly white, and the starch grains should be aggregated into little lumps. With hot water it should readily form a jelly, which should be firm, colourless, transparent, and good tasted,

* Compiled from Church on *Food*.

and which should keep from turning sour for three or four days. Arrowroot is very largely adulterated, but the inferior matter may be easily detected by the microscope, as true arrowroot starch bears characteristic markings on its granules. Being easy of digestion, and non-irritating, arrowroot is much used by invalids, but less so than formerly. Many other plants yield arrowroots, but they are all of inferior quality to the one got from the Maranta.

Tapioca should be prepared from the tubers of the *Manihot utilissima*, or cassava plant, growing largely in Brazil. The juices of the roots are poisonous, but the poisonous principle is removed by heat, and the granulated starchy matter left from the process is highly nutritious. Much of the tapioca of commerce, however, is made from sago or from the potato, and is much inferior to 'Rio' tapioca.

Sago.—The best kind of sago is made from the pith of the sago palm (*Sagus farinifera*), but much in the market is made from other plants or from potato starch. Sago is usually sold in a round form, large or small, and brown or white, the latter being the former bleached. Both tapioca and sago are useful foods, being light, nutritious, and non-irritating; and made into puddings with milk, their use is much to be commended, especially for the young.

36. **Other vegetable Articles of Food.**—Of all our English vegetables, the **potato** is the one most largely used. It contains only a small amount of flesh-forming matter, and is very deficient in fat. Its starch, however, is very digestible when properly cooked, and the vegetable acids and salts present in the tuber make it very useful as an anti-scorbutic. Some serious forms of skin disease have entirely disappeared since the introduction

of the potato from America into this country, by Sir Walter Raleigh, in the reign of Elizabeth. As the amount of water is large (75 per cent.), and the salts small (1 per cent.), 8 to 12 ounces should be taken daily if no other vegetable is eaten. The proportion of flesh-formers in potatoes being so small, we cannot use them as a complete food, but they must be accompanied by buttermilk, lean meat, or other nitrogenous foods.

Artichoke.—There are two varieties of this used as food. One is a plant belonging to the same order as the sunflower, and is called the Jerusalem artichoke. It can be easily and cheaply grown, and as furnishing more variety in our vegetable dietary, deserves to be more used than it is at present. Its tuber, unlike the potato, contains no starch. It does not therefore become floury when boiled. The place of starch is taken by an amyloid substance termed inulin, and in addition there is also some sugar. Of the other variety (the true artichoke), the young buds, leaves, and blanched leaf-stalks are eaten after having been boiled or pickled.

The **carrot** contains no starch, and but ·5 per cent. of albuminous matter. Its value as an article of diet depends on its containing 4·5 per cent. of sugar. The **parsnip** belongs to the same botanical order as the carrot (the *Umbelliferæ*), but its root contains 3.5 per cent. of starch, a small amount of albuminoids, some sugar, fat, and mineral matter. It is often eaten with salt beef or pork, but its peculiar taste, smell, and texture, make it to be disliked by many persons. The **turnip**, both the white and the Swede varieties, contains but little nourishment. It contains no starch, the place of which is taken by a jelly-like material termed pectose,

the principle of which is *pectin*, whose true value is hardly yet made out.

37. **Green Vegetables.**—These being mainly formed of cellulose, contain comparatively little nourishment, but still they form valuable additions to our dietary. The salts they contain possess, like the potato, valuable anti-scorbutic properties; the cellulose, though little nutritive (if any) in itself, acts as a stimulant to the digestive organs, and its bulkiness is a valuable factor in its use, as it gives a feeling of satisfaction, and it can be more easily acted upon by the digestive organs than more highly concentrated food. The **cabbage**, when young, consists of about 90 per cent. of water, 1·5 per cent. of albuminoids, and as much as 6·3 per cent. carbonaceous matter. It is therefore more nutritious than some of the roots before mentioned—notably the turnip.

Varieties of the cabbage (all derived from the same parent source) are *Brussels sprouts*, *Scotch kail*, *savoys*, *red cabbage* (always eaten pickled), and the *cauliflower* and *broccoli*. Besides these various plants, the green leaves of several others are eaten after being cooked. **Spinach**, an Asiatic plant, is a wholesome vegetable containing nitre, and is cooling and laxative in its nature. **Seakale**, of which the blanched stems and leaf-stalks are eaten, is an agreeable and wholesome vegetable. **Asparagus**, like seakale, a cultivated variety of a wild seaside plant, contains an alkaloid (asparagine) which acts as a diuretic. The **vegetable marrow** contains a large proportion of water, 2 per cent. of sugar, and a little starch and albumen. It has a delicate flavour and pleasant consistence.

SALADS.

38. These form a pleasant variety of food, as helping to give bulk in an agreeable form, and in eking out small quantities of meat. In former times, many green vegetables, which are now entirely neglected, were used for the purpose of making salads. Some of these might be reintroduced into this country with advantage. Salad plants usually contain but little nourishing material either of a nitrogenous or a carbonaceous kind. Their value consists in their being comparatively rich in saline matters; for example, potash salts, which are of importance in a medicinal point of view to the body. They also serve to introduce large quantities of water into the system, and are thus refreshing additions to richer foods, especially in hot weather.

They should be used freshly gathered, and too much care cannot be bestowed on cleansing them for the table. The plants used in England for salads are the lettuce, celery, water-cress, radish, cress, endive, chicory, beetroot, tomato, sorrel, &c. The **lettuce** is the most generally used of all vegetables which are eaten uncooked. It contains little else but water and 1 per cent. of mineral matter, chiefly nitre.

Celery.—This plant is used in more ways than lettuce, for its blanched leaf-stalks are eaten raw or stewed for a table dish like seakale, cabbage, &c., while the tender tops are introduced into soups, or form a salad herb. Celery is much more nutritious than lettuce, containing 5 per cent. of heat-forming and flesh-forming matter.

Water-cress is remarkable for the mineral matter it contains. It owes its pungent taste and medicinal

properties to the presence of an essential oil. It has a pleasant acidulous yet warm taste; it should be eaten when young, and be very carefully cleansed from adhering animal matter. The **radish** has a pungent taste. It should be grown quickly, so as to be tender and not bitter. **Cress** is a plant usually sown with mustard, and will grow easily in any moist place. The **endive** and **chicory** both belong to the same order of plants, and their blanched leaves are used as salads. The **sorrel** contains oxalic acid, and is much more used in France than in England as a salad herb. The **cucumber** should be rapidly grown, and eaten fresh, but at the best it is a somewhat dangerous food, resulting often in indigestion and diarrhœa. The rind should never be eaten. **Beetroot** may appropriately be mentioned here, as it forms an ingredient in many salads, but unlike the others just mentioned, it is a valuable food. It contains 10 per cent. of sugar, and thus it is a useful heat-former as well as a pleasant addition to a salad. The **tomato** is now much more used in England than formerly. It contains *malic* acid, which gives it a pleasant acidulous taste; and besides its use as a salad, it is valuable as a sauce for many dishes. It has also considerable medicinal value.

39. **Fungi.**—There are at least three species of these plants used in this country as food—the common mushroom, the morel, and the truffle. The latter two are only within the means of the rich, and are chiefly obtained from abroad. But the common mushroom forms a nice dish, being highly nitrogenous and containing much fat. It may be stewed, boiled, or pickled. Several other kinds of fungi are eatable, but the difficulty of distinguishing the edible from the poisonous

varieties is so great, that it is hazardous for ordinary persons to attempt to use any other than the common mushroom (*Agaricus campestris*).

Several kinds of *seaweed* are used locally as foods in this country, and one *lichen*, namely, Iceland moss.

FRUITS.

40. These form an increasingly useful class of foods, though many of them are esteemed rather for their pleasant or refreshing taste than for any nutritive value they may possess. Still, some fruits, such as the fig, date, banana, &c., are of the utmost dietetic value to the populations that have to depend upon them largely for sustenance, while others have a high medicinal value, for example, the lemon and the lime, which are so useful in counteracting the evil effects of a diet of salt meat.

But all fruits *have* a nutritive value, if a small one; and besides this, they serve (1) to stimulate a weak appetite by their juiciness and flavour; (2) to give variety and lightness to an otherwise too solid diet; and (3) they contribute in a most palatable and refreshing way much of the water required by the body for digestion and assimilation of food.

Their bulk is largely made up of **pectose**, a substance much resembling starch in its composition, and which being boiled, or ripened, as in fruits, changes to a vegetable jelly termed **pectin**. Pectose proper is found characteristically in the pear and peach. Other fruits consist of very nearly similar substances, all of which are classed for the sake of brevity under the name pectose. 'There is good reason for believing that all the substances belonging to the pectose group are capable of digestion and absorption in the human

body,'* and are thus true foods of more or less value.

Fruits should not be eaten unripe or over-ripe, as in both states they contain chemical substances which produce diarrhœa and other derangements of the system. Care should also be exercised not to eat the rind or skin, for irritation and sometimes fatal inflammation of the intestines are often caused by the indigestible woody material of which the rind, &c. are composed.

41. Of all English-grown fruits, the most valuable probably is the **apple**. It is extensively used in pies, puddings, sauces, and confectionery, as well as for dessert. There are numerous varieties, but a good ripe apple will consist of about 17 per cent. of solid matter, of which about 7 per cent. is sugar, 5 per cent. is pectose, &c., 1 per cent. malic acid. From the juice of apples cider is made. The **pear** is less adapted for culinary purposes than the apple. Some varieties ripen early, and soon decay; others require to be stored months before being fit for use. Some are useful for baking, others for stewing. Pears contain rather more water and sugar than apples, but less malic acid and pectose. From the juice of some kind of pears a strong fermented liquor called perry is made. The **quince** is a pear-shaped fruit, used chiefly as a flavourer with other fruits, and as marmalade or jelly. The **medlar** belongs to the same order as the foregoing, but it is remarkable for not being eatable till it has undergone a peculiar change scientifically called 'bletting,' by which it loses its acid and tannin, which make it sour and astringent when first gathered.

* Church.

42. **Berries.**—Of these there are many varieties; but probably the most extensively used is the **gooseberry**, which is a most wholesome fruit when cooked or preserved. The acid in these berries is citric, and on an average they contain 7 per cent. of sugar.

Black, red, and white currants do not differ much in chemical composition from the gooseberry. The first forms a valuable preserve, very useful in cases of sickness, especially from sore throat; while of the other kinds (as of the gooseberry), tolerable British wines are made. The **strawberry** consists largely of water, but has a rich fragrance and flavour, which makes it a favourite dessert fruit, especially when eaten with cream. The **raspberry** has a most delicate flavour, and is largely used, mixed with other fruits, as a preserve.

The **blackberry** is the best of our wild fruits, and it is a loss to the nation that it has never yet been systematically brought under cultivation. The **dewberry, barberry, bilberry, whortleberry, cranberry**, and **elderberry** are all examples of wild fruits turned to use as preserves, &c. The **mulberry** is but little grown in England, and has a most peculiar flavour.

43. **Grapes.**—In these the acid is tartaric, and when ripe, the amount of sugar (glucose) is considerable, being about 13 per cent. They are thus twice as nourishing as gooseberries. Grapes can be grown in the open air in the south of England, but they do not come to perfection north of 40° N. latitude. Of late years, a great trade in the importation into England of foreign grapes—notably Jaffa grapes—for dessert use, has sprung up. There are 1500 varieties of the grape vine, and it is from their produce that the many kinds of wine known throughout the world are made.

Some grapes are dried, and are then called raisins,

used for eating alone, as Muscatels, or in puddings, as Valencia and Sultana raisins. One variety, the produce of a small species grown in the Ionian Islands, has been misnamed a currant.

44. **Drupes.**—This name is given to all the fruits which have a hard stony seed surrounded by a fleshy pericarp. To this class belong the **peach, nectarine, apricot, plum, cherry,** &c. The last mentioned contains much sugar, sometimes to the extent of 10 per cent.; but the others, while having much less sugar, possess 10 per cent. or so of pectose, before described. These drupaceous fruits must be considered less wholesome than those mentioned previously. Their skins are indigestible, and their kernels contain an oil which has in it a peculiar principle identical with prussic acid. The **date,** which forms an important food eaten in eastern lands, is composed very largely of sugar when ripe (54 per cent.), and there is a fair amount of nitrogenous matter present as well. It is so valuable a fruit, and can be used in so many ways as food, that the natives who possess it affect to pity those who have it not.

45. The **banana** is an important article of food in Western Africa, &c. It is a nutritious fruit, having less water and more nitrogenous food in it than are found in most fresh fruits. The sugar is about 20 per cent., and the albuminoids about 5 per cent. We may here mention an article of food which, though extensively used as a fruit, is the stalk of the leaf of a plant, namely, **rhubarb.** Its sour taste is due to oxalic acid, and by cultivation, various flavours have been developed in different varieties. The agreeable taste and odour of the stalk is not brought about till it is cooked. Its chief use is as an addition to other fruits, or for making

pies, especially when artificially grown, but its food value is very small. A delicious wine can be made of its expressed juice.

46. **Figs**, of which there are several kinds, are brought to this country, already dried and pressed, in great quantities from the Mediterranean ports. They contain even more sugar than the date, but less water. In fact, all the varieties of food substances are well represented in them.

47. **Nuts** contain much nitrogenous matter, little starch, but often as much as 50 per cent. of fixed oil or fat. They are therefore rich food, somewhat difficult of digestion, and need to be taken in moderate quantities with lighter food. The oil, especially when the fruit is old, is liable to become rancid and unwholesome. The **walnut** contains more than 12 per cent. of albuminoids when ripe, and when green, makes an excellent pickle. The **hazel-nut, filbert**, and **cob-nut** have much the same composition, and contain 8 per cent. albuminoids, and also 11 per cent. of starch, &c. The **almond** should always be eaten blanched, as the brown skin of the kernel is highly indigestible. From another variety (bitter almonds) the dangerous poison prussic acid is obtained. The **cocoa-nut** has a kernel rich in oil and sugar, while the 'milk' is, when fresh, a nourishing and pleasant beverage. The **chestnut** forms an important article of food in Southern Europe. Its composition is exceptional, and it might be included among the bread-stuffs, as it is so rich in starch, and contains so little fat. Abroad, its meal is made into cakes, and the nuts are eaten when boiled or roasted. The **ground-nut**, from which palm-oil is largely obtained, belongs to the leguminous plants. These nuts contain 50 per cent. of oil. They are used as human food in

West Africa, but are imported into this country for the purpose of obtaining palmatin for commercial purposes. There are many other varieties of fruits called nuts more or less used as food, for example, **pistachio, hickory, Brazil**, &c.

48. **The Orange Family.**—Probably no fruits are so useful to man, or are used over so wide a range, as the orange and its kindred fruits the lime, lemon, citron, shaddock, &c. They all have in their rind fragrant essential oils, which cause their 'peel' to be used as flavourers of other food. The fruits have a direct alimentary value, from the sugar, &c. they contain, and a medicinal value, because of the varying quantities of citric acid and citrate of potash found in them. Oranges are imported into England in vast quantities, the finest fruit being brought from the Azores (St Michael's), but the orange can only be tasted to perfection when taken perfectly ripe from the tree. The **lime**, the **lemon**, and the **citron** have done more than any other kind of food to remove the dreadful disease of scurvy, from which so many people suffered before the introduction of these fruits.

As our trade and enterprise extend, many more fruits become known and used by us, such as **pine-apple, pomegranate, prickly-pear, tamarind**, &c.

CONDIMENTS.

49. Under this term we include materials used for the purpose of flavouring foods and rendering them more palatable. They increase the appetite by increasing the tastiness of food, and they aid digestion when used with moderation. Condiments owe their value to the presence of essential oils which are volatile—that is, may be dissipated by moderate heat.

Mustard is widely used. It is prepared from the seeds of *Brassica nigra*, or *alba*. It promotes digestion by stimulating the secretion of gastric juice, but the excessive use of it produces disease of the liver. It should be made with warm but not boiling water.

Horse-radish contains the same oil as is developed in mustard. It is used chiefly with roast beef, but is not so wholesome as mustard, because the scraped root may adhere to the intestines and produce indigestion, if not worse results. Horse-radish is thought by some to have a medicinal value in cases of rheumatism.

Pepper grows in abundance on the Malabar coast, and in the East and West India Islands. If the berries be gathered before they are ripe, and dried in the sun, they form black pepper. White pepper is made from the same berry when ripe. The dark pericarp or covering is then easily removed, and the pepper becomes less pungent. The essential constituents of pepper are an acrid resin, a volatile oil possessing the flavour, and a substance known as *piperin*. It is somewhat stimulating and heating in its nature, and is largely used in hot countries, as is also **Curry Powder**, a mixture of many substances, used for the purpose of stimulating the sluggish action of the liver.

Parsley, used in sauce and for stuffing, **mint**, **thyme**, **marjoram**, **fennel**, **garlic**, **sage**, and several other plants, are used, sometimes as articles of food, but chiefly as condiments.

Under the head of condiments we may also place **vinegar**, the essential constituent of which is acetic acid. It is largely made from malt. The wort being subjected to the continuous action of the atmosphere, causes acetous fermentation to take place, the result being

pure vinegar, one of the most valuable of condiments, and one we could least easily spare. It also prevents the decomposition of animal and vegetable substances, and its use with salads of various kinds is most important.

SPICES.

50. These are substances usually added to articles of food containing sugar, while condiments are mostly eaten with meat. Spices make food more tasty, and perhaps stimulate the secretion of digestive fluids, and so aid digestion.

Ginger is the dried rootstock of a reed-like plant growing in the East and West Indies. Its odour is due to an essential oil, and its hot taste to a peculiar resin. The young shoots are often boiled in sirup, and are then sold as a sweetmeat—preserved ginger.

Cinnamon is the inner bark of a small evergreen tree grown in Ceylon. It contains a fragrant essential oil, which gives it an agreeable odour and pleasant taste. It is largely used as a medicine as well as for flavouring purposes.

Nutmegs are the seeds of a tree cultivated largely in the Dutch East Indies. They contain about 6 per cent. of an aromatic and pungent essential oil which makes the nutmeg to have a similar value to cinnamon **Mace** is the *aril* or covering lying immediately over the nutmeg.

Cloves are the dried flower-buds of an evergreen tree grown in the West Indies. They contain a pungent aromatic oil in considerable quantity, and are used in flavouring apple tarts, puddings, &c.

Other less important spices are *allspice*, *caraway seeds*, *coriander seeds*, and *cassia*.

DIET.

51. The necessity of a mixed diet has already been made plain. It is highly important as well that the diet should be duly proportioned and sufficient. A badly proportioned or insufficient dietary is sure to lead to failure of health. Certain natural causes call for a variation in quantity and kind of food. These are age, sex, time of year, climate, occupation, &c. Thus the young child requires only milk, while the strong man needs meat or some highly nitrogenous food. Women generally require a less amount of food than men. The hard worker requires more than the idler, and the outdoor labourer, as a rule, more than the clerk or factory operative. So also the rapid oxidation of tissue experienced by the Eskimo necessitates the use of a large amount of fatty matter; while the Hindu, living in a warm climate, needs but little fat, and subsists chiefly on rice or pulse. At middle life, as the body is fully matured, less food is required than in early manhood. Too much food taken at this period often results in corpulence, or lays the foundation of gout and other diseases.

The question whether it be possible to dispense with animal food, and live on vegetable material alone, has been much debated of late. Certain it is, that health can be maintained for a long time on vegetable food. The subject, however, is largely a question of climate. Animal food has in its favour that it is more convenient, concentrated, and piquant, and that it usually comprises in itself the various kinds of food needed, without the disadvantage of great bulk. All medical men are agreed that animal food is indulged

in by most people to excess, and that it would be a positive advantage to the health of the community to use more vegetable food than at present.

52. **Determination of Diet.**—First, it must be mixed, that is, proteids, amyloids, fats, salts, and water must be represented; second, it must be so proportioned that the balance between supply of food and the loss by wear and tear, growth and oxidation, may be maintained; third, it must be varied according to the liking, employment, or other circumstances of each individual. Professor Corfield states that the average amount of food consumed daily by an adult taking moderate exercise, is found to contain the following weights of *dry* food substances:

Nitrogenous substances........	4½ oz.
Fats..............................	3 "
Carbo-hydrates..................	14¼ "
Salts..............................	1 "
Total...........	22¾ oz.

or about 40 oz. of moist solid food.

Besides this, from 40 to 60 ounces of water are taken daily in the form of beverages, &c. Drs Letheby, Playfair, and Edward Smith give somewhat larger quantities than the above.

Dr Playfair gives the following table of daily diets, according to work done:

Daily Diets for	Nitrogenous.	Carbonaceous.
Subsistence only......	2·0 oz.	13·3 oz.
Quietude...............	2·5 "	14·5 "
Moderate exercise....	4·2 "	23·2 "
Active labour..........	5·5 "	26·3 "
Hard work.............	6·5 "	26·3 "

53. Taking moderate exercise, then, as a starting line, it will be seen that in quietude or idleness the amount required diminishes in about the same proportion as it is increased by activity or hard work. From the above table we notice that the proportion of nitrogenous food to carbonaceous is under the first three conditions 1 to 6, in active life 1 to 5, and in hard work 1 to 4. Speaking generally, 4100 grains of carbon and 200 grains of nitrogen are required daily by the adult in mere activity, and 4800 and 300 grains respectively during hard labour, a proportion of 1 to 16. The difference between these two statements is only apparent, and not real, as nitrogenous food contains a large proportion of carbon in addition to the nitrogen present.

54. **Maintenance of Diet.**—Taking, then, 306 grains of nitrogen and 4800 grains of carbon as the needed daily material for a working man, it may be got from eating 5000 grains (about $\frac{3}{4}$ lb.) of lean beefsteak, 6000 grains of bread, 7000 grains of milk, 3000 grains of potatoes, and 600 grains of butter—or about 50 ounces of solid food altogether. If bread be substituted for the potatoes and milk, the quantity needed would be reduced to 44 ounces. If a man lived on beef alone, he would have to eat 44 ounces in order to obtain the necessary carbonaceous material, but he would have far too much nitrogenous material. If he lived on bread alone, 50 ounces would have to be eaten in order to get the needed nitrogen, but the supply of carbon would be excessive.

It follows, then, that while the most economical diet, in all senses of the word, is that which contains both nitrogen and carbon, there is no one article in which they can be found in suitable ratio. Nature

therefore teaches us, and science confirms the wisdom of it, when any particular food is deficient in any single constituent, to associate it with another which contains an excess of that constituent. Thus certain kinds of animal food which are deficient in fat, such as veal, fowl, and liver, are always associated with ham or bacon. In like manner, we use butter or oil with certain fishes. Again, in making puddings we add butter, milk, or eggs to rice, sago, or tapioca; cheese is eaten with bread, bacon with beans or cabbage, and oil with salad.

55. **Meals.**—Meals should be sufficiently far apart to allow the stomach and nervous system about half as long to rest in as they have been working, and the last meal should be had at such a time that the stomach, &c. may have nearly total rest during the hours of sleep. Three meals a day are, physiologically enough, one of which may be heavier than the others. The most substantial meal for those engaged in outdoor manual labour may be taken in the early or middle part of the day, but those persons who are engaged in sedentary labour or intellectual pursuits had better dine when the labour of the day is over. As a rule, less food is required in summer than in winter, and meals for those who are old should be often and small in amount. Regularity as to meals is very important, as the digestive organs acquire habits like other parts of the body. If the regular time be long past, and faintness be experienced, a large amount should not be eaten, as the stomach will be unable to digest a full meal. Active exertions should not, if possible, be made immediately after a meal, as these tend to abstract blood from the digestive organs, and so impede digestion. To fulfil all its purposes, food must

be wholesome, digestible, and free from irritants. Food differs much in its digestibility, and this point is a great factor in its use. As a rule, those articles are the most satisfying and nutritious that take about three hours to digest, such as eggs, lean meat, &c.*

THE PREPARATION OF FOOD.

56. **Cooking.**—Man is the only animal that cooks his food. Many foods in an uncooked condition he could hardly digest at all, and therefore they must be subjected to the power of heat as exercised in cooking. But man also cooks that he may improve the flavour, piquancy, and pleasantness of food. Salads are eaten uncooked; fruits both cooked and uncooked—milk also. The oyster (sometimes mussel) is the only animal eaten raw; all other animal and vegetable food is cooked.

57. **Objects of Cooking.**—1. To render food more digestible. 2. To render it more attractive by de-

* With reference to the relative digestibility of food, the following table, compiled from the well-known experiments of Dr Beaumont on Alexis St Martin, will give some general idea:

TIME REQUIRED FOR DIGESTION.

	H.	M.		H.	M.
Rice, boiled	1	0	Lamb, broiled	2	30
Tripe, boiled	1	0	Potatoes, baked	2	33
Eggs, taken raw	1	30	Beef, boiled	2	45
Apples (sweet and mellow), raw	1	30	Apple Dumpling, boiled	3	0
Venison Steak, broiled	1	30	Beef, roasted	3	0
Salmon Trout, boiled	1	30	Mutton, boiled	3	0
Sago, boiled	1	45	Mutton, roasted	3	15
Tapioca, boiled	2	0	Oysters, stewed	3	30
Codfish cured and dry, boiled	2	0	Wheaten Bread, baked	3	30
Cabbage (pickled raw)	2	0	Potatoes, boiled	3	30
Eggs, roasted	2	15	Eggs, hard-boiled or fried	3	30
Turkey, boiled	2	25	Fowls, boiled or roasted	4	0
Beans, boiled	2	30	Ducks, roasted	4	0
Goose, roasted	2	30	Beef, fried	4	0
Sucking Pig, roasted	2	30	Cabbage, boiled	4	0
Potatoes, roasted	2	30	Pork, roasted	5	15

veloping its flavour, aroma, &c. 3. To give a greater variety to our dietary, and to serve the same article in various ways. 4. To destroy internal parasites. 5. To prevent putrefaction. 6. In preparation for cooking, to cleanse the food from useless parts, parasites, &c.

MODES OF COOKING.

58. **Roasting.**—This is the most perfect way of cooking meat. It brings out its flavour better than any other method. In roasting meat, the primary design must be not to draw the nourishing juices of the meat away, but to imprison them amidst the solid fibres of the flesh. This is managed by exposing the meat at once before a clear red-hot fire, so that an outer case of coagulated albumen may be at once formed. After some ten minutes of such roasting, it is advisable to cook more slowly, always, of course, attending to the frequent basting of the meat with the hot fat that flows from it. The meat in this way will get well done, but it will not be dried; it will consist of a well-apportioned admixture of coagulated albumen, fibrin, and natural juices. The time required for roasting is about fifteen minutes to the pound for beef, mutton, or goose; for veal and pork, twenty minutes, and if the joint be large, some allowance over and above these rates must be made. When the meat is done may be ascertained by pressing it firmly with a spoon. If it retain the impression, it is done; if it be still elastic, it is not fully cooked. Meat loses much in weight by roasting, as the fat is melted and drips away, and much of the water is evaporated. The total loss is about 30 per cent., but the amount very much depends on the age and manner of feeding the animal—the flesh of a young and artificially fed animal shrinking a great deal.

59. **Baking.**—In cooking meat in a closed oven instead of the front of an open fire, less weight is lost, because less of the water of the juices is steamed away. But it has not so pleasant a flavour as roasted meat, as it acquires a taste which is somewhat unpleasant, from the confined vapours. If the oven be ventilated by a small opening in the door, meat may be so baked as scarcely to be known from roasted. In the case of meat baked under a crust, as in pies, the unpleasant flavour is not imparted. The oven should always be very hot when the meat is first put in, so as to coagulate the albumen at or near the surface. After ten or fifteen minutes, the temperature should be lowered by pushing in the damper or removing the meat to some part of the oven more remote from the fire, taking care that for the rest of the time the temperature is as regular as possible.

60. **Boiling.**—In boiling meat, regard must be had to the end in view. If it be desired that the liquor shall be rich in the juices of the meat, the joint must be put into cold water and slowly cooked. The result will be good broth or liquor suitable for stock. But if the object is to have the joint as nutritious and tasty as possible, it must be put into boiling water and cooked quickly for five minutes, after which it should only be allowed to simmer at about 180° F. Soft water should be used in all cases for boiling meat.

61. **Stewing** is the best mode of cooking hard, tough, lean meat. It is a process intermediate between baking and boiling, and consists of placing the meat in a covered stew-pot with a small quantity of water, and cooking it at a moderate temperature for a long time, the time being of greater importance than the amount of heat, but the latter should never be above 180° F.

By this method the juices are drawn out from the meat, and the liquid so prepared forms part of the dish as served. The fibre of the meat is also much disintegrated by the combined action of heat, water, and steam, and the result is that stewed meat is always tender, and can easily be rendered tasty by the use of sweet herbs, condiments, &c. The only objection to stews is, that the meat being saturated with gravy, becomes too rich for weak stomachs.

62. **Hashing** is an objectionable method of stewing previously cooked meat. The double cooking usually renders the meat tough and indigestible. Simply warming the cold sliced meat through, is better than hashing it.

63. **Frying**, as usually done, is a wasteful and objectionable process. It consists in cooking small pieces of meat in melted fat in a frying-pan, and as this fat can be made considerably hotter than boiling water, it follows that if too great a heat be employed, the fibre of the meat is rendered hard and tough, and as each fibre becomes coated with fat, it is also rendered difficult of digestion. The great aim should be to fry lightly, that is, quickly, and without burning any part. Some things, as omelettes, soles, &c., should only be fried in a small amount of fat, while many things are cooked best when immersed in it. In all cases, the fat should be melted and heated before the article is placed in it. Fish is especially adapted for frying if the proper amount of fat at the proper temperature be provided. The fish should be wiped dry, and dipped in a thin batter of flour and water before it is placed in the pan.

64. **Broiling** and **grilling** are similar processes to roasting, differing only in the fact that small pieces of

flesh are exposed to the fire instead of a joint. In the former, the meat is often quickly cooked by the help of a reflector of heat—the Dutch oven. For successful grilling, the requisites are a clear, smokeless, hot fire, a clean hot gridiron, and frequent turning by tongs (not a fork) of the meat about once a minute. The chop or steak will then be juicy, well done, and nice flavoured.

65. **Soups.**—These are much more largely used on the continent than in England. They afford a means of providing cheap, tasty, and nutritious food for the poor. The soups of the rich are often very expensive, and their very concentrated richness makes them to be unsuitable to be taken except in small quantities. Any scraps, except pure fat, can be used in soup-making; bones especially of great use, being rich in gelatin—two ounces of broken bones furnishing more gelatin than sixteen ounces of meat. Cold gravy, broken meat, and all bones should therefore be taken care of, as being good material to form stock for soup. If these be placed in a stew-jar, covered with cold water, slowly cooked, and well skimmed of fat, the resulting liquid will be a rich stock capable of dilution and of mixing with vegetables, &c. to form a nutritious soup. The advantage of using soups as an economical means of relieving the poor in time of great distress, may be seen from the following recipe taken from Dr Ed. Smith's *Practical Dietary:* 'Soup to make a hundred rations—Meat liquor from 7 lbs. of beef and 1 lb. of bones; split peas, 13 lbs.; carrots and Swede turnips, each $6\frac{2}{3}$ lbs.; onions, $5\frac{1}{2}$ lbs.; leeks, $\frac{1}{2}$ lb.; salt, pepper, and dried herbs. (Carbon, 490 grains; nitrogen, 36 grains per ration. Cost, 1d. per ration.)'

66. **Cooking of Vegetables.**—These, as a general

rule, require to be put in plenty of water containing a little salt, and to be boiled quickly. Potatoes, when cooked by boiling, should be put into boiling water, but most potatoes when ripe are best steamed. The most important point about their preparation, whether boiled or steamed, is to allow them when done to dry thoroughly by steaming off superfluous moisture. It is a dry mealy state which constitutes their excellence. Baked potatoes are somewhat more nutritious than steamed, as they lose more water, and they are certainly more wholesome. It is of first importance that potatoes be thoroughly cooked, because if the starch granules be not burst, the starch will not digest, and pain and diarrhœa often result from the eating of badly cooked potatoes. Peas and beans, when ripe, require long and slow cooking, and should be steeped for some hours before putting into *soft* water for cooking.

67. **Baking of Bread.**—Good bread is of so much importance in our daily dietary, that too much skill cannot be exercised in making it. The flour should be dry and pure; German yeast is preferable to brewer's, as the latter is sometimes bitter, and its action is also less to be depended on; everything should be warm—the flour, the bowl, and the water in which the yeast is dissolved. Cold retards the growth of the yeast plant, and so does salt, which should be placed near the edge of the flour, the dissolved yeast being in the middle. When vesicles have formed freely on the liquid surface, the batch is ready for kneading, which should be thoroughly done, so that the yeast plant may penetrate every part of the dough. It will now rise if kept still and warm. For baking bread, a steady oven is the greatest requirement. By the heat the growth of the torula (yeast plant) is stopped, and the carbonic acid

resulting from fermentation is liberated, leaving the bread light and vesiculated.

Pastry is much less digestible than bread, in consequence of the starch granules becoming coated over with fat, and thus rendering the whole mass hard to be broken up by the digestive juices. Many persons have to avoid pastry altogether. The crust of puddings made of suet, and suet puddings themselves, need well boiling, and are then much more digestible than pastry made of dripping or lard. In making puddings, many other farinaceous substances besides wheat-flour are used, such as rice, sago, semolina, tapioca, and when properly made, they are all nutritious and wholesome, as they are easy of digestion and pleasant to the taste.

68. **Cooking Apparatus.**—This consists of ranges, stoves, and kitchen utensils. Ranges are either *open* or *closed*. The open range is still the most commonly used. Its advantages are that it insures ventilation, and allows the roasting of meat in front of the fire. Its disadvantages are its smoke, dust, and soot, the last being liable to fall, and thus spoil the roasting joint; its waste of fuel, seven-eighths of the heat going up the chimney; and the fact that only a limited number of dishes can be cooked at the same time.

The closed range, or **Kitchener**, has much in its favour. It consumes but little fuel, and can be made to burn almost anything; also many things can be cooked at once on it, either by boiling or baking. The objections to its use are that it makes the air of the kitchen hot and dry, requires more attention from the cook than the open range, and will not allow of roasting before an open fire. Excellent ranges of both kinds are now easily obtainable, and good cooking is thus much facilitated.

69. **Gas Stoves.**—The use of these for cooking purposes is rapidly increasing, especially where the price of gas is so low as to make its use to be as economical as that of coal. They may be had of all sizes, from the small one costing 1s. 6d., and useful for boiling the kettle or a pan of potatoes, to the largest, capable of meeting the requirements of a large institution or household. They are cleanly, and always ready for use, and

A Medium-sized Gas Cooking-Stove.

the amount of heat required for cooking the various dishes can be easily and exactly regulated. All the operations of roasting, baking, boiling, frying, grilling, and steaming can go on together, if required, by using these convenient articles. Attention must be paid to

their ventilation, otherwise meat cooked in them may have an unpleasant flavour.

Besides gas stoves, there are others, chiefly portable, which are heated by an oil or spirit lamp. The **Norwegian cooking-stove** can also be carried about, and will cook, by the aid of a small quantity of inclosed boiling water, a fowl, a pudding, &c., for use when travelling.

70. **Kitchen Utensils.**—The **frying-pan**, of the use of which little can be said favourably, for it is generally wasteful and unsatisfactory, should be kept thoroughly clean, and so washed that it does not cause anything to taste of that which has been previously cooked in it. The **gridiron** is a valuable article for cooking chops, steaks, &c., as before described in grilling. Its bars should be kept scrupulously clean. **Saucepans**, made of good block-tin or iron, are needed of various sizes for boiling puddings and vegetables, and for sauce-making. One, at least, should be fitted with a steamer for doing potatoes and other articles by steaming. The **spit** is used in roasting, and the **Dutch oven** for broiling or cooking small dishes in front of the fire. As this article performs its work by reflected heat, its use is highly economical. A utensil which acts on the same principle is the **hastener.** This, by protecting the fire and meat from draughts, regulates the heat when a joint is roasting. A **digester** is a utensil that should be in every home. It is a strong iron pot with a screw-lid and valve, and in it bones, gristle, &c. may be subjected to a temperature far higher than boiling-point. Dr Papin, its inventor, claimed for it 'that the oldest and hardest cow-beef may be made as tender and savoury as young and choice meat.' All the valuable properties to be derived from stewing bones for stock-making

are obtained by the use of the digester. It takes up little room, and may stand at the back of a stove, where neither soot nor smoke can affect it. Something similar to this last is 'Warren's Cooking-pot,' which insures but little loss of weight by cooking.

SECTION II.

WATER AND BEVERAGES.

WATER.

71. **Its Composition.**—Water is a chemical compound of the gases oxygen and hydrogen. Its chemical name is *hydrogen monoxide*, the symbol for which is H_2O. If hydrogen be burned in air, water is formed by the union of that gas with the oxygen of the air, two atoms of hydrogen uniting with one of oxygen to form a molecule of water. The most striking method of demonstrating its composition is analytically—by splitting it up into its constituent gases by means of a current of voltaic electricity, when it is found that the amount of pure hydrogen gas coming off from the zinc end of the battery is just double in bulk the amount of oxygen given off from the platinum end. By weight the proportions are 15·96 of oxygen, and 2·0 of hydrogen.

Water is the most universally diffused substance in nature, being found as a large constituent of all organic bodies and of all inorganic matter, even of the rocks of the earth's crust. The human body is composed of about three-fourths water; that is, the body of a man weighing 154 lbs. has, according to Church, 109 lbs. of water in it.

72. **Sources of Water.**—If the question be asked:

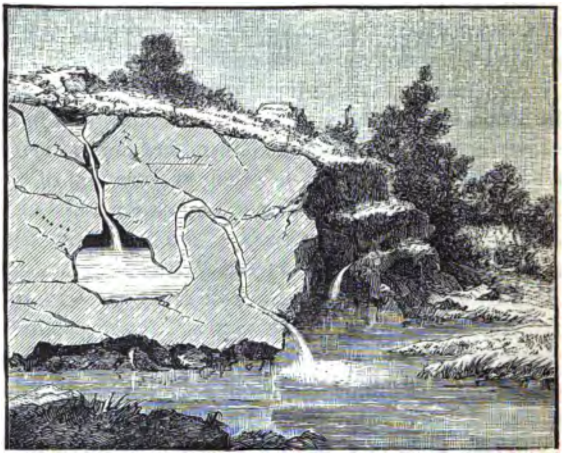
'Whence come our supplies of water?' we might reply: 'From rain, from streams, springs, and wells.' But if we trace the matter back, we shall see that all the fresh water on the earth's surface has been derived from the ocean by a vast process of distillation, first being suspended in the atmosphere in the form of aqueous vapour, and then by condensation becoming rain, snow, and dew, by which our rivers and springs are fed.

When water, in its return from the clouds as rain, falls upon the earth, one part of it is absorbed by the soil, while another part runs down the slopes in order to find the lowest possible level or position of rest. It thus at first forms one or more mountain rills, which after a time unite into a brook. The stream proceeds on its downward course, augmented as it gets farther from its source by the addition of other streams, till it broadens into a river, whose size is further swollen by tributaries. Reaching low ground, velocity diminishes, it broadens out into a tidal stream, and ultimately loses its identity in the ocean. Sometimes the course of the stream is interrupted for a time by the formation of a lake in some hollow, but onward it goes like the Rhone through the lake of Geneva, on its downward journey to the Mediterranean.

But what becomes of the water absorbed by the soil? It sinks through the porous strata till it meets with an impervious one, as clay. It can then go no farther vertically, but must run off laterally, thus forming a mountain or land spring. If the water which passes into the soil collects in some hollow in the earth's crust, and is tapped at a point below the level of the earth's surface, an artesian or artificial spring is formed. The other forms of water which contribute to our water-supply are snow (forming glaciers, out of

which run streams), ice, hail, hoar-frost, dew, and fog.

73. **Kinds of Water.**—The water which descends as hail, snow, or rain is in a very nearly pure condition. When drawn up by evaporation into the air, no solid



A Spring.

substances are drawn up with it, and so when first condensed in the forms just mentioned, it is in a state of purity it can never preserve after having fallen through the atmosphere to the earth. Such water is denominated *soft* water, and it is also the purest kind of natural water, there being no truly pure water but that distilled by chemists.

Water soon becomes charged with carbonic acid, which gives it increased solvent powers; and if it passes through or over rocks such as it can dissolve, it becomes charged with solid matter from those rocks, such as carbonate of lime (chalk), sulphate of lime

(gypsum), sulphate of magnesia (Epsom salts), oxide of iron (iron rust), alumina, and silicon. These insoluble earths give a harsh feeling to such waters, which are therefore called *hard*. The most noticeable effect of hard water is on soap, which it curdles by neutralising the acids contained in it, setting free the fats which are not capable of lathering, but which resolve themselves into a curd destitute of detergent powers. In fact, the properties belonging to the soap which make it of use are destroyed.

The hardness of water is comparatively estimated by the 'soap test'—that is, by finding the amount of soap which it can destroy. If 12 lbs. of best hard soap have to be added to 10,000 gallons of water, before a permanent lather can be produced by agitation, the water is said to possess one degree (1°) of hardness, and so on. But nearly all waters possess more than this amount of hardness, and seeing that a family of eight persons would use easily 8000 gallons of water annually for washing purposes, a great loss of soap (equal to 200 lbs. if the degree of hardness is 20) would take place. The amount of money thus wasted in towns with a hard-water supply can easily be estimated. In London fully one-third of the tea used is wasted owing to the use of hard water.

Hard water may be rendered softer by boiling, in which case the carbonic acid gas is driven off and the earths are separated in an insoluble form. If they fasten on kettles and boilers, the deposit so made is called 'fur.' In steam-boilers it forms a very hard incrustation which lessens the power of heating the water very considerably. To prevent this incrusting, various boiler compositions for mixing with the water are sold.

74. The use of soda also softens water, but the most extraordinary method is Dr Clark's. Water can only hold a certain quantity of limy salts in solution, and if what is termed the **point of saturation** is reached, the whole of the earths are precipitated. Dr Clark has shown how, by adding one ounce of quicklime to every 1000 gallons of water for each degree of hardness, in twelve hours' time the water will become soft, clear, and quite fit for drinking purposes; and this is the plan now adopted by some of the water companies whose supply is hard.

As regards health, it has never been conclusively proved that hard waters are prejudicial to health, though it is believed they are likely to produce stone in the bladder and kidneys. Many persons prefer the brisk hard waters instead of the comparatively flat and insipid soft waters, but for domestic purposes there can be no doubt as to the immense superiority of soft water. In washing, it more easily dissolves greasy and sticky matters, and takes less soap, thus saving time, soap, and fuel. Soup and beef-tea are sooner and better made by it; less tea is required in 'brewing' that beverage when soft water is used, and meat will boil more tender and in less time in it than in hard water. Peas, beans, cabbage, and cauliflower boiled in hard water, acquire a yellow colour, and are also hardened. As all salts and alkalies are unfavourable to the growth of the yeast plant—the active agent in fermentation—bread will not 'sponge' so soon with hard water as with soft.

75. **Good Drinking Waters.**—These may be either hard or soft. The latter are decidedly to be preferred, as they are more often free from impurities; but the former have the advantage of being brisker and more tasty, and

the carbonates of sodium, calcium, and magnesium, when present in them in small quantities, are not likely to do any harm. If these mineral impurities be present in large quantities, it is believed by some that they promote the formation of calculi in the bladder and liver. Water contaminated by organic matter is unfit for drinking purposes. No water is absolutely free from such matter, but if present to any appreciable extent—as, for example, in the water occasionally supplied by the London water companies, which take their supplies from the Thames and the Lea—such waters cannot truly be called *good* drinking waters. The water supplied to Glasgow from Loch Katrine has no hardness, and only $2\frac{1}{2}$ grains of solid matter per gallon. The presence of ammonia in water makes it a suspicious article, as it commonly indicates contamination by putrefied organic matter. The water of surface wells, rivers, and land-springs is often thus contaminated by its having dissolving manure or other decaying animal or vegetable substances. It is the presence of unoxidised organic matter that makes any drinking water dangerous. Such matter is usually accompanied by bacteria, the active agents in the propagation of infectious diseases. A good drinking water should be clear and without smell, be well aerated, have a scarcely perceptible flavour, contain the least possible amount of foreign matter, and should not curdle soap if used for washing.

76. A good method of examining water to determine its colour and turbidity, and consequently its value as a drinking water, is to pour a sample into a tall clear glass vessel about two feet high, placed on white paper. A similar glass filled with distilled water should be placed by its side for comparison. Both samples must be looked through from above, and the differ-

ence between them noted. Perfectly pure water has a bluish tint, and the bottom of the vessel is very distinctly seen. Organic vegetable matter is denoted by a green tint. Clay and suspended sand give a yellowish tinge, peat a dark-brown colour, and sewage a light-brown colour. If turbidity be considerable, so as to obscure the bottom of the vessel, or if the water be seen to have little particles of stringy matter floating in it, it may be pronounced unfit for use, though filtration, and more particularly boiling, may render it perfectly wholesome.

CISTERNS AND WELLS.

77. **Cisterns.**—In many parts of our country there is no organised method of supplying water to the inhabitants, and they have to depend on that which can be caught and stored as rain water, or on the water from deep or surface wells. Rain water, though nearly pure as it falls, is soon contaminated by soot and other solid materials on the slates or tiles, and by other impurities it easily meets with. It is therefore best to filter it. This can be done by passing it from a catch-pit through layers of gravel and coarse sand, before storing it in the supply cistern. All cisterns and tanks used for storage of water for drinking and domestic purposes, should be covered in and ventilated. They should also be periodically cleaned out, as soot and dust settle at the bottom of tanks belonging to small houses, and while the water is thus cleansed by precipitation, the cistern gradually fills up with black mud.

Reservoirs and tanks for large supply are built of earth or stone, but cisterns and tanks for small service are made of stone, brick, slate, lead, iron, or zinc. Of

these, slate is the best. The cistern should be made of large slabs of it, bolted together and made water-tight by cement, not mortar, as that would dissolve and make the water hard. Stone and brick yield to the action of water, and are soon in need of repair. Lead is objectionable, for soft water usually dissolves some of it, and lead-poisoning may result. Iron, though much used, soon corrodes, and sometimes gives the water a deep-brown colour. When used, it should be galvanised. Zinc is said to be a good material, but it may produce similar results to lead in a less degree.

A common cause of mischief in houses is from the overflow pipe of the cistern which communicates with the sewer not being trapped, and thus the sewer gas passes up to the cistern, and being confined by its cover, is absorbed by the water. It is better for the waste pipe to open out into the air through the wall direct, or to be carried down outside to open over a gully. A cistern which supplies a water-closet should never be used to supply water for cooking or drinking purposes, as the supply pipes may convey bad air to the cistern. Hence, a small cistern, of which there are some good kinds, should be supplied to each closet. Cisterns are also needed to supply kitchen and other boilers, and are usually placed in the upper parts of houses. They should be so placed as to allow of easy access to service, supply, and waste pipes.

78. **Wells** are really reservoirs formed in the ground, and are supplied by the spontaneous rising of water in them from springs, or by water running into them from the strata. As the water penetrates the ground, it absorbs a good deal of carbonic acid gas from the air held in the interstices of the soil. It also dissolves a good deal of the soluble matters in the soil, especially

by the aid of the carbonic acid it has in suspension. Thus well water may have in it a good deal of solid matter per gallon. The carbonic acid makes it sparkling and pleasant to the taste. The great danger is, that the water may be contaminated by sewage matter or organic matter drained in from the surface. Sometimes the soil in which the well is sunk is so pervious, that sewage matter from cesspools or from drains on higher ground percolates through it and pollutes the water. A surface well should therefore be placed remote from dwellings, be well built and cemented, and if there be much subsoil soaking, lining with iron to a good depth, as in the case of pit-shafts, is advisable. The water of deep-bored wells is generally good, and forms a better supply than that drawn from streams and springs, which is apt to become contaminated by the drainage of houses close by. If a natural reservoir be tapped below its level, it flows upward of itself and forms a true artesian well.

SOURCES OF CONTAMINATION.

79. **Deleterious Effects.**—We have seen that no natural water is absolutely pure. Of rain water, Dr Angus Smith says, that if it were possible to collect it from the clouds, it would require filtering through the soil before being fit for drinking purposes. The impurities present in waters are: (1) Mineral—those which make the water either permanently or temporarily hard. (2) Organic—those which are derived from decaying animal or vegetable matter, or which consist of organisms themselves—vegetable, as *confervæ*, *bacteria*, and *bacilli*; animal, as *amœba*. (3) Gaseous, which may be still further divided into (*a*) ordinary; (*b*) occa-

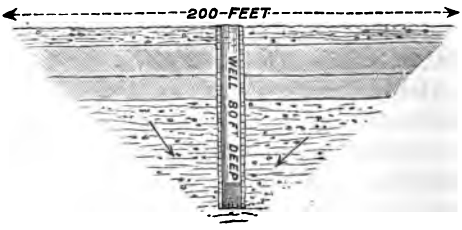
sional. The first class can hardly be regarded as impurities, inasmuch as they increase palatableness; the last are only present when absorbed from cisterns, &c. (see pars. 77 and 78), owing to defective or badly arranged piping. It is the impurities of the second class which make the water containing them to be dangerous, and to the presence of which the term contamination can only be fitly applied.

80. Following the classification proposed by Dr Parkes, we observe:

(1) *Water may be contaminated at its Source.*—Hence the importance of choosing a good 'collecting ground' for the water of large towns. Water from alluvial formations, and surface and subsoil waters, are likely to be impure from sewage contamination. Cultivated lands, with richly manured soils, yield a water containing often both organic matters and salts in large quantity; and in towns and among the dwellings of men, the surface water and the water of shallow wells contain a large quantity of nitrates, &c. When surface water is collected from heaths or high moorlands far removed from towns, it is usually a good article, and is stored and conducted to centres of population for use. Water at times flows through graveyards to lower levels. Such water contains much ammoniacal salts and organic matter, which make it putrid on standing for a few hours. Water from loose sand and gravel occasionally contains much impurity. 'The water from the sands on the Landes (Southern France) contains enough organic matter to give ague' (Parkes). Rain water may be contaminated by washing the air it falls through, but more so by decaying matters it meets with on the roofs of houses and other places.

(2) *Water may become contaminated during its Transit from Source to Reservoirs.*—The impurities that are acquired by rivers, brooks, canals, and other watercourses are: (*a*) sewage; (*b*) manufacturing. The former includes the solid and liquid excreta, and the house and waste waters from towns and villages. The second comprises all the refuse from dye-works, bleaching works, tanneries, paper, woollen, and silk factories, &c. Many of our large towns were till recently dependent on their rivers for water supply, but so impure did it become, that necessity has compelled them to abandon such sources, and seek for pure surface, river, or lake water at remote distances. The sewage matter is usually nitrogenous, and is not much dissolved in the water, but remains suspended as very fine particles, which either finally undergo chemical change or are precipitated as mud.

(3) *Water may be contaminated in its Storage.*—Whether stored in wells, tanks, reservoirs, or cisterns, the chance of substances getting into the water is very great, and cases are constantly occurring where sickness



Section showing Drainage Area of Well.

is spread over larger or smaller areas by organic impurities contained in the water thus stored. Shallow wells, when sunk in pervious strata, receive the soakage

from the ground, or sewage matter from cesspools and drains in their vicinity. Their influence extends very far, for they drain the soil in the shape of an inverted cone. Thus, one of 80 feet depth would drain an area with 200 feet as diameter on the surface. Contamination of **cisterns**, which easily takes place, has already been spoken of (pars. 77, 78).

(4) *Water may be contaminated during its Distribution.*—Pipes may be broken and may thus allow foul surface-water to enter them, as was the case in a Lancashire town a few years ago, where, in consequence, a serious epidemic of typhoid fever was experienced. Lead and iron pipes may be partly dissolved; in the former case, leading to very serious illness, or if the pipes be allowed to become empty, they may draw in sewage matter or sewer and coal gases, and in this way even the water of the mains has been fouled.

81. **Effects of Water Contamination.**—It is not satisfactorily proved that mere mineral impurities (excluding metals) promote disease in the human system, though it is alleged that dyspepsia, diarrhœa, and calculi have been caused by certain mineral matters suspended in water. *Goitre*, a disease called in this country Derbyshire Neck, and which is also common in Switzerland, is believed to be caused by drinking waters containing mineral impurities, probably some salt of iron or of copper, but in what way is not yet known.

82. **Lead**, as we have just said, does produce serious disease. The purest and most highly oxygenated waters are those which act most on lead, but carbonic acid gas in water exerts a protective power against lead poisoning. The amount that is deleterious is so small ($\frac{1}{100}$ of

a grain per gallon), that its presence often is for a long time undetected. The symptoms it produces are indigestion, colic, 'drop-wrist' (which is a paralysis of the muscles of the forearm), gout, disease of the kidneys, &c. **Iron** in water is usually beneficial, but it may be so much in excess as to produce constipation and headache.

83. Nothing, probably, in medical science, has been more clearly established than the relation between contaminated water and the occurrence of **typhoid fever.** Again and again outbreaks have taken place which investigation has proved to have been caused by the use of fouled water. This fever *may* be caused by breathing air contaminated by sewer gas, but it is four times as common a result from drinking water that contains, even in the smallest degree, *matter that has previously passed through the body of an affected person.* This distinction must be noticed, for it is now pretty clearly established, that while ordinary fæcal matter may produce diarrhœa, which may be accompanied with fever, yet for the production of **enteric, typhoid,** or '**drain**' fever, as it is called, the specific agent must be present. So many cases have occurred which clearly illustrate the fact just stated, that it may be well to cite one. In November 1853, about 140 persons from widely separated homes met at two public balls held at a hotel in Cowbridge, Wales. A few days after they had returned home, many were attacked with typhoid fever of a most virulent type, and as many as eight died from it. Now, these people had never been in each other's company except in the Cowbridge ball-room, and no others were attacked but those who had thus met, or members of their families. On investigation, it turned out that a case of fever had occurred in the

hotel just before the balls were held; the patient recovered, and had left previous to the commencement of the festivities. There was consequently no contact with him, nor was there any reason to believe that the air of the room was concerned in communicating the disease. An examination of the out premises, however, proved that the contamination had come through the water used. The cesspool and the drain which had received the discharges from the fever patient were in close contiguity to the well which supplied the water that many of the guests had partaken of; in this way the infection was spread. The defects of the building were of course remedied, and its sanitary arrangements are now perfectly satisfactory.

Typhoid fever, then, which has become so fatal of late years, is a decidedly preventable disease if people are only careful what water they drink. They should never take water that is at all turbid, or has any smell, and if there is any doubt about its source, it should be boiled before using. Filtration will remove almost everything from water, but it is proved from certain cases, notably that of Lausen in Switzerland, that no amount of filtering is sufficient to remove disease germs from poisonous water; boiling alone will destroy them.

84. **Diphtheria**, or malignant sore throat, very contagious and fatal, and attacking children more than adults, is undoubtedly in many cases owing to the taking of water contaminated with sewage.

85. **Cholera**, the most deadly epidemic, is due to its specific poison gaining an entrance into drinking water. The recent investigations of Koch seem to prove that the active agent in the disease is a specific bacillus, and this probably can only enter the body in the way

just mentioned. An epidemic of cholera has been unknown in this country for nearly twenty years, and before that time the disease had marvellously decreased owing to improved water supply. Thus, in Glasgow, in the epidemic of 1849, with a polluted water supply, 3772 persons died of it; but in 1866, with a pure water supply, only 68 died. The relation between the spread of cholera and bad water is still further proved by what took place in London both in 1854 and 1866. In the first year, for example, 26,000 houses were supplied by the Lambeth Company with water taken from Thames Ditton, and 40,000 houses were furnished by the Southwark and Vauxhall Company with Thames water taken at Battersea. The houses lay in the same district, side by side, the pipes often interlacing, and all the surroundings were the same, yet while of those supplied with comparatively pure water from Thames Ditton, 294, or four per 1000, died of cholera; of those drinking the foul water taken at Battersea, no fewer than 2284, or thirteen per 1000, died of that disease.

The effects of impure water, then, are spread of typhoid fever, cholera, and diphtheria, and in a less degree scarlet fever, sore throat, erysipelas, and skin diseases are due to the same cause.

BEVERAGES.

86. This term is applied to those liquids which are taken as drink. Of course the best beverage is pure water, but in all ages and in all countries there has been manifested a craving for warm drinks or for fermented ones. In this country, warm drinks are almost

a necessity of our climate, and all persons, with but few exceptions, take one of the following: coffee, tea, cocoa, or chocolate at breakfast or tea-time.

TEA, COFFEE, COCOA.

87. **Tea** is used by more than half the human race. Its flavour depends very largely on the nature and situation of the soil where grown, time of year when gathered, and mode of preparation for market. The spring crop has the best flavour, and forms green tea; in the summer crop the leaves are of a dull green colour, and form black tea. Tea depends for its value on the presence of an *alkaloid* principle called *theine*, which, when obtained free, takes the form of silky white crystals. It will only dissolve out of the leaf on the application of boiling water; good tea contains 2½ per cent. of theine. The aroma of tea is owing to the presence of a volatile essential oil. In addition to the theine and oil, there are also present minute quantities of several acids which act as tonics, and so far the effect of tea is good, often helping digestion. But there is considerable tannic acid in the leaf, and that is dissolved, if the tea be stewed, its effect being to harden and injure the stomach wall. Although tea has little nutritive value, it increases

Tea-plant.

respiratory action, and excites the nervous system to greater activity.

88. **Coffee** is prepared by roasting the seeds of the *Coffæa Arabica* till they take a reddish-brown colour. In this process a volatile oil, having a powerful aroma, is developed. The alkaloid in coffee is termed *caffeine.*

Coffee, with section of fruit.

There are also present an astringent acid and 15 per cent. of albuminoids. Coffee, like tea, acts on the nervous system, but more quickly, and it accelerates the action of the heart. It checks perspiration, and is a valuable antidote in cases of poisoning by opium, alcohol, or arsenic. Coffee has been much adulterated

by chicory, which is prepared from the root of the wild endive. Chicory contains no alkaloid like theine or caffeine, and is therefore of no use as a refreshing or stimulating agent. It is generally harmless, but when largely used it produces diarrhœa and sickness in some persons.

89. **Cocoa** is obtained from the seed of the cacao tree, a species of theobroma, growing in South America. Its principle is called *theobromine*, and it acts much in the same way as the principles of tea and coffee. The clean cocoa seeds, after being dried and roasted, are broken into fragments known as nibs, which have about 50 per cent. of fat in their composition. But most of the cocoa used now is prepared by removing the cocoa-butter and adding starch or sugar. Under this form it is less likely to disagree with dyspeptic persons than pure cocoa. Cocoa is highly nutritious, containing 20 per cent. of gluten and 22 per cent. of starch. Theobromine is mild in its action on the respiratory and nervous systems. Cocoa is much to be preferred to either tea or coffee for the use of young persons as a beverage.

Cocoa.

Chocolate is simply cocoa ground up with sugar and

flavoured with vanilla, cinnamon, &c. It is more used as a sweetmeat than as a drink.

FERMENTED DRINKS.

90. These are so called, because by the process of fermentation the sugar at first present in them is broken up and forms a new compound termed alcohol. Carbonic acid is liberated, which gives to such liquors their effervescing property. Alcohol is a colourless liquid, having a pleasant vinous odour, a strong attraction for water, and evaporating rapidly when exposed to the air. It burns with a bluish, sootless flame, and is a strong solvent for such substances as resins, but it hardens and preserves animal tissue. Pure alcohol is an undoubted poison. It abstracts water from the tissues of the body with such avidity as to destroy their vitality. If taken into the stomach, it would probably cause fatal inflammation. The fermented drinks containing it may be classed as *malt liquors*, *wines*, and *distilled spirits*. In the first class the amount of alcohol varies considerably from 1½ per cent. in small beer to 8½ per cent. in Burton ale. Porter, made from roasted malt, contains 5 per cent., and stout, a stronger kind of porter, 6 or 7 per cent. The hop which is added to these drinks gives to beer its characteristic bitterness, and causes bitter ale to have a stimulating and tonic effect upon the stomach.

91. **Wines** are produced by the fermentation of the juice of the grape, though, as we have previously seen, home-made wines are prepared from many kinds of English fruit. **Foreign Wines** differ according to method of preparation, kind of grape, soil on which grown, &c. Champagne and similar wines are bottled before fermentation is complete, and are therefore effervescing

and sparkling. When fermentation is nearly completed before bottling, a dry wine is obtained, such as Bordeaux. Red wines, such as Port, have the skins fermented with the juice, and the colouring matter is thereby expressed. At the same time, salt of iron and tannin are dissolved from the skins. Thus a pint of Bordeaux contains a medicinal dose of iron, and the roughness of port is due to the tannin present in it. As time passes, this tannin becomes insoluble, and forms the crust of old port. Free acids and acid salts are contained more or less in all wines, tartaric acid, cream of tartar, and acetic acid being the chief. They are present in somewhat large proportions in clarets and hocks, a fact which makes these wines very digestible to most people. The quantity of alcohol in wines varies very much. Claret may have as little as 5 per cent., while some kinds of port contain as much as 20 per cent.

92. **Spirits.**—These are simply dilutions and flavourings of pure alcohol, which has been distilled from wheat, malt, fruit, &c. *Brandy* should be made by the distillation of wine, but it is often nothing more than diluted alcohol, coloured with burnt sugar and flavoured. *Whisky* is distilled from malt, and contains fusel oil when new, which is injurious to health; this spirit should therefore be kept for several years before being used. *Gin* is spirit flavoured with the juniper-berry and other aromatic substances. *Rum*, made from molasses, contains a good deal of solid matter, and a large percentage of alcohol.

With reference to the quantity of alcohol contained in spirits, it may be stated that few that are sold contain more than 49 per cent. of pure alcohol. Proof spirit is spirit mixed with one half water (the real

proportions are fixed by Act of Parliament: 49·24 alcohol, 50·76 water by weight). For every additional ·5 or ½ per cent. of pure alcohol, the spirit is said to be one degree above proof.

93. **Effects of Fermented Liquors.**—It was formerly held that beer and wine were necessaries, but the experience and increased research of the last few years have proved that they are to be classed entirely as luxuries. Life can be passed under the most healthy conditions, and with constant activity of brain and muscle, without their use at all. The sole use they can have is medicinal, and as such they should be taken only on the advice of a medical man, and in the way other medicines are prescribed.

In studying the physiological effects of alcohol, we must distinguish between the taking of a moderate dose, namely, about one ounce, and the taking of large doses, as the results are sometimes the very reverse in the two cases. Small doses stimulate the stomach, produce temporary congestion of the liver, slightly impede respiration, increase the force of the heart's action and the rapidity of the circulation, diminish the quantity of oxygen in the blood, and in some persons dull the power of thought and perception, while in others they increase rapidity of thought and flow of words. Their effect on the muscular system is always detrimental. The power of controlling delicate movements is lessened, and the capacity for sustained labour is decreased. The temperature of the body is at first slightly raised, but is soon after lowered beyond its normal point, and diminished oxidation favours deposition of fat in the tissues. Any good accomplished by the use of alcohol may be attained by the use of simple medicines, and the evils and dangers

of its use are so great, that strong drink is best avoided by any one in a healthy condition. Unhappily, in the United Kingdom the use of immoderate doses is sadly too common; some individuals drink large amounts daily, which from their being engaged in hard manual labour, are oxidised in the system without any apparent serious results. But these are exceptional cases.

The usual results of immoderate doses of alcohol are acute inflammation of the stomach-wall, causing in the end loss of all power of digestion; the liver becomes seriously diseased, its tissues become changed, and dropsy often results; the lungs are clogged with the growth of fibrous tissue, and a tendency to chronic bronchitis is induced; the heart and blood-vessels become diseased, and the blood has its amount of oxygen seriously diminished. The nervous system, next to the liver, suffers most; the alcohol acts as a narcotic, induces a dullness of faculties which is followed by stupor, and total insensibility, if large doses continue to be taken. Delirium tremens and insanity are occasional results of alcoholism; and it is also found that the evils of drunkenness may be transmitted, for the children of drunkards are specially liable to scrofula, hydrocephalus (water on the brain), and idiocy.

94. **Gout**, a most painful disease, is sometimes caused by long indulgence in the drinking of beer and such wines as port, especially in those who are not actively employed. The urea that should be given off by the excretory organs of the body is retained, and urate of soda is formed from it. This settles in the joints and other parts, causing the inflammation and intense pain so characteristic of gout.

SECTION III.

AIR.

95. **Its Composition.**—Air is a *mixture*, not a chemical compound, of two gases, oxygen and nitrogen, in the proportion by volume of 21 parts of the former to 79 of the latter. **Oxygen**, a colourless, invisible gas, possessing neither taste nor smell, is the *active* constituent of air, being indispensable for the respiration of animals, and also for the process of combustion. **Nitrogen**, also a colourless, invisible, tasteless, inodorous gas, is useful only to dilute and mix the oxygen, and is remarkable chiefly for its negative properties.

Besides these two gases there is always found a third, most important to the vegetable world, as furnishing largely the material for its growth, namely, **carbon dioxide**, commonly called **carbonic acid gas**. It is colourless and inodorous, but possesses a slightly acid taste. It is heavier than common air, its specific gravity being 1·529 (air being reckoned 1), and it is easily taken up by water; the sparkle of drinking-waters, and the effervescing of natural and manufactured mineral waters, being due to its presence. It occurs in natural air in the proportion of nearly 4 volumes in 10,000. Carbon dioxide is a resultant of fermentation, combustion, and respiration. It will not generally support combustion,* and is fatal to human life, being a non-respirable gas.

* Potassium and magnesium *will* burn in it, uniting with the oxygen, and setting free the carbon.

It forms the choke-damp of coal-mines, and on account of its superior density, is found in hollow places, such as the bottom of old dry wells, empty vats, &c. Were it not for the operation of the law of the diffusion of gases, which keeps it constantly mixed up in the atmosphere in the proportion just mentioned, the carbon dioxide would settle down on the earth's surface to the depth of 17 feet or so, and all animal life would cease.

96. **Aqueous Vapour.**—All air also holds in suspension a greater or less amount of watery vapour, taken up chiefly by evaporation from the surface of the earth. The amount varies considerably in various localities, and at various times in the same locality. Thus the east winds of England contain but little vapour, while the south-west winds coming from the broad Atlantic are laden with moisture. The presence of aqueous vapour in air is made evident to us by its condensation into mist and cloud, and by its deposition as dew, rain, and snow.

97. **Ammonia.**—All average pure air contains a trace (about 1 part in one million) of *ammonia*, a substance chiefly obtained from the decomposition of animal and vegetable matter containing nitrogen and hydrogen, but its presence ought probably to be considered as that of an impurity rather than that of a constituent of common air.

AVERAGE COMPOSITION OF ATMOSPHERIC AIR.

Oxygen............	209·6 in 1000 volumes.
Nitrogen	790·0 " "
Carbonic acid......	0·4 " "
Watery vapour.....	varies with temperature and direction of winds, &c.
Ammonia............	trace.

98. **Ozone.**—The air of mountain and seaside districts also contains a gas which is believed to be a peculiarly condensed form of oxygen, and to which the name of ozone has been given. It is thought to be a resultant of continuous discharges of electricity from the clouds to the earth, acting upon the oxygen of the air in the same way that artificial discharges are found to do. It is a powerful bleaching agent, and it is popularly believed that a climate containing much ozone is a healthy, exhilarating one, but 'the subject of the presence and effects of ozone, interesting as it is, is very uncertain at present.' *

99. **Impurities in Air.**—Many substances are constantly passing into the atmosphere, and probably it would be impossible to find any air quite free from foreign substances. Usually they are present in large numbers, as is seen when a ray of sunlight, passing through a hole in a window-shutter, and crossing a darkened room, shows an infinite number of motes in constant agitation. Experiment and microscopical investigation prove these to consist of (1) dust, sand, &c. from the soil; (2) chloride of sodium, &c. lifted by the wind from the ocean; (3) fragments of such kinds of matter as constantly and immediately surround us, for example, fragments of vegetation such as hay, straw, hay seeds, hairs of plants, cotton and flax fibres, starch granules, and pollen; fragments of animal material, such as feathers, insects' wings, and epider-[illegible] scales. There are also spores of fungi, and the [illegible]s of mould and mildew, which will speedily grow [illegible]e conditions be favourable. It is in this way that [illegible]r *mucedo*, a fungus growing upon paste, jam, [illegible] is propagated. All the foregoing impurities are

* Parkes.

either entirely or comparatively harmless to human life, but there are other impurities which are productive of some serious diseases, and are the most active agents in spreading others.

In the air of towns, noxious gases are often present in considerable quantities, for example, hydrochloric acid and sulphur dioxide. The former escapes from alkali works, while the latter comes from the burning of coal and metal-ore containing sulphur, and from bleaching-works. They have an injurious effect upon vegetable and animal life, sulphur dioxide and sulphur trioxide notably producing bleeding from the lungs, when breathed even in moderate quantity. Sulphuretted hydrogen and marsh gas are also sometimes found in air, having been given off by decaying organic matter.

The impurities acting as agents in the generation and transmission of zymotic or infectious diseases are still more serious. They consist (1) of filthy dust and effluvia, resulting from want of cleanliness of home or person; (2) of bad gases and effluvia from sewers, house-drains, cesspools, ditches, &c. By these, typhoid fever, diphtheria, diarrhœa, pyæmia (blood poisoning), erysipelas, scarlet fever, and similar diseases, are engendered and spread.

100. Of the part played in the spread of disease by the many *living* organisms in the air, we are not yet sure, though it is believed that *bacteria* and *bacilli*, minute vegetable growths belonging to the class *Schizomycetes*, *do* communicate disease. Thus in wool-sorter's disease, bacilli have been found in the body of the patient, most likely inhaled from the atmosphere in which the person had worked. The German physiologist Koch has also lately demonstrated the presence of bacillus, to which he gives the special name of *Bacillus tuberculosis*,

in consumption, and the possibility of the disease being propagated by it. He also affirms that a specific bacillus is largely present in the intestines of persons suffering from Asiatic cholera, and is probably the cause of that disease.

101. **Effect of Respiration on Air.**—The chief purposes of breathing are the purifying of the blood and the generation of animal heat. Both these objects are attained by one act, namely, the oxidation of carbon in the blood capillaries of the lungs. The oxygen of inspired air passes by osmose through the walls of the air-cells and the walls of the capillaries overlying them, into the blood-current, and uniting with the carbon, forms carbon dioxide (CO_2), and in doing so evolves heat. This CO_2 passes out by the same law, through the same walls into the air-cells, and is expelled by the act of expiration. The changes produced by respiration on atmospheric air, are: (1) It is warmed, (2) its carbonic acid is increased, (3) its oxygen is diminished, (4) its watery vapour is increased, (5) a small amount of organic matter and free ammonia is added to it. It follows, therefore, that the *same air* breathed over and over again must become heavily charged with carbonic acid, which, as we have said, is a poisonous, non-respirable gas, and such air is utterly unfit for blood oxidation, and the other purposes of breathing. The air of rooms is also vitiated by combustion of coal gas and the burning of coal in our grates, and the outer air of large towns receives from the many chimneys an immense amount of carbonic acid. The late Dr Angus Smith calculated that in Manchester, not less than 15,000 tons of carbon dioxide are thrown out daily from the numerous chimneys of that city. From these considerations we see the necessity of ventilation.

102. **Amount of Air necessary for each Person.**—It is computed that a man gives off from his lungs ·79 of a cubic foot of carbon dioxide, or carbonic acid, every hour, or 19 cubic feet for every 24 hours. Reckoning that his breath contains 5 per cent. of carbonic acid, it follows that he poisons $\cdot 79 \times 20, = 15 \cdot 8$ cubic feet per hour, or 380 cubic feet of air in 24 hours. If combustion of gas be going on in the room, as well as respiration, then the carbonic acid is increasing at a much more rapid rate, an ordinary gas-burner producing about 6 feet of carbonic acid per hour. It may easily be conceived, then, how soon the atmosphere of a crowded and brilliantly lighted ballroom becomes impure, and the great value in this respect of the electric light for illuminating rooms of public assembly. Now, when this gas is in greater quantity than ·06 per cent. in the air of a room, it is in excess, and the air is unfit to be breathed, not only because of the evil nature of carbonic acid itself, but chiefly because the capacity of air for taking up and holding noxious animal matter and aqueous vapour increases as the quantity of the gas increases. The organic matter makes itself known by its smell. Dr Parkes says: 'It may be fairly assumed that the quantity of air supplied to every inhabited room should be great enough to remove all sensible impurity, so that a person coming directly from the external air should perceive no trace of odour, or difference between the room and the outside air in point of freshness.'

But, to keep the carbonic acid at the point mentioned, namely, ·06 per cent., it is found by experiment that it is necessary to supply no less than 3000 cubic feet of pure air per head (adults) per hour. If this standard of purity be considered too high, as involving too great cost in schools, workshops, or public buildings, and

·7 or ·8 be taken, the amount of fresh air required per hour will be 2000 and 1500 cubic feet respectively. As a fact, the amount of cubic space allowed to each person in newly-constructed barracks is 600 feet; in modern school buildings, 1000 feet; and in hospitals, such as St Thomas's, London, 1800 feet; while in lodging-houses the amount fixed under the Act is only 300 feet. This last is much too low, as it involves change of atmosphere no less than twelve times in an hour to keep it up to the above-mentioned standard, a thing which we need scarcely say is never done, and if it were attempted, would be impracticable on account of causing great draughts. As it is not possible with comfort to change the air of a room more than three or four times an hour, it follows that the amount of 1000 cubic feet of space is the most natural; in other words, a bedroom 10 feet square and 10 feet high ought only to contain one person.

It is notorious that many dwellings, to say nothing of workshops, are very much under this mark, and are often worse than even the common lodging-house. Rooms with low ceilings, lean-to bedrooms, cellar dwellings, and small houses in very narrow courts, are much too common. The building of cottages and other houses with loftier rooms, the opening out of new streets in our large towns, and the removal of 'rookeries' in the metropolis and in our large towns, together with the operation of the various Sanitary Acts, have much improved the general health of towns, have diminished diseases, especially fever, and lowered much the national death-rate (see page 161).

103. **Movements of Air brought about by Changes of Density.**—These changes are always the result of changes of temperature. It is a property of all gases when

warmed to expand and become lighter, and so currents are created. The air we breathe is warmed in its passage through the lungs, and consequently, when expired, it rises and passes away from us. The air heated by the fire in the grate or by the burning coal-gas is changed in density, and rises up the chimney or to the ceiling of the room. The initial force causing it to rise comes from the pressure exerted upon it by the denser air surrounding it. A warm column of air ascends not from any power of its own, but on account of the pressure exerted upon it by a denser column. In like manner, a balloon ascends because the heavier air around it exerts a force on it which bears it upward. Winds are produced by the working out of this law. A body of air heated by intense radiation from a scorched surface, like that of the land in the torrid zone, becomes lighter and ascends to the higher regions of the atmosphere, being replaced by cold currents possessing greater density, which flow from the poles. This movement is the direct cause of the trade-winds and monsoons, as well as of all other winds which are but modifications of these. A change of density in air is also brought about by the greater or less amount of moisture taken up by air—that is, the greater the amount of aqueous vapour held, the less is the density of air.

Within an inclosed space, the movement caused by change of density acts thus: The air is heated by fire or the presence of men and animals, or it may become moister. It then endeavours to expand, and if it can find any means of escape, a portion of it does escape, and that which remains is thereby rendered lighter than an equal bulk of the outside air. This, then, will rush into the room by every available opening, until the equilibrium between the air outside and that inside is

re-established. But so long as the inclosed air is being heated, that equilibrium is not established, for a portion of the incoming air is in its turn heated, and passes out. Thus a constant stream is kept up, cold air entering by one set of apertures, and hot air escaping by another. To regulate this, and to make it effectual, is the purpose of all true ventilation. Of course, where the air to be changed is equal in temperature to, or colder than the external air, resort must be had to other means.

104. **Deleterious Gases and Injurious Inhalations.**—Gaseous matters are constantly passing into the atmosphere from natural causes, or as the result of manufactures. These are—various compounds of carbon, sulphur, chlorine, phosphorus, and nitrogen, besides such vapours as arise from decaying organic matter in sewers, &c. We have seen that **carbonic dioxide** is given off in respiration, fermentation, and combustion, and that consequently the air of inclosed spaces, and of town streets and courts, often has it in excess, that is, more than 1 part in 2500. Cases are often happening where men in mines, old wells, vats, and limekilns, lose their lives from breathing this poisonous gas. When life is not sacrificed, or men are not disabled from their work, headache, sickness, and loss of appetite are produced by breathing air containing more than the normal quantity of carbon dioxide. Three per cent. produces great difficulty of breathing, five per cent. is absolutely fatal.

Carbon Monoxide (CO) is one of the products of coal combustion, and is intensely poisonous, producing death when inhaled even in very small quantities ($\frac{1}{2}$ to 1 per cent.). It rapidly affects the red corpuscles of the blood, so that they no longer are carriers of oxygen, and the person dies asphyxiated. Poisoning by it chiefly occurs where charcoal is burnt, and where there is but

little oxygen available, as in a small bedroom. Cases of accidental poisoning, or of suicide by this means, are common in Paris.

Sulphuretted Hydrogen is a gas given off from chemical works, especially in the making of ammonia. It is also a considerable constituent of sewer air. When taken in small quantities, and that continuously, it seems in some cases harmless, in others hurtful. Many persons working at processes involving the giving off of this gas seem no worse for it, while others are affected by feebleness, lose their appetites, and suffer from convulsive and similar dangerous symptoms.

Carburetted Hydrogen.—This may either be *light* (CH_4), as fire-damp found in coal-mines, and marsh gas produced by the decomposition of dead vegetable matter; or *heavy* (C_2H_4), which is an important constituent of coal gas. Both of these may be breathed for a short time up to 20 or 30 per cent., but above this, symptoms of poisoning, headache, vomiting, convulsions, and stertorous breathing, are produced.

In the manufacture of vulcanised india-rubber, toy balloons, &c., **carbon disulphide** (CS_2) is evolved. It is very poisonous, and affects strongly the nervous tissue, and in this way most serious complaints are produced.

Sulphurous Acid gas is always found in the air of large towns in small quantity, derived from burning coal and gas, but men employed in bleaching works, in cotton and worsted manufactures, are the most exposed to it. It produces bronchitis and similar affections.

105. Besides these gases, we may mention certain poisonous inhalations or fumes, to which men employed in various trades are exposed. These are—**ammonia**, irritating the eyes; **hydrochloric acid, nitrous**

acid, and **chlorine,** all of which affect the lungs unfavourably.

Artificial flower makers are exposed to the fumes of **arsenical** preparations. Makers of mirrors and thermometers, and also gilders, are liable to suffer from **mercurial** poisoning. Mercurial fumes are even more dangerous to the health than arsenical, for they cause sore mouth, loss of teeth, sleeplessness, acute pains, paralysis of the muscles, besides eruptions and ulcers of the mouth and nose. Etchers suffer from fumes of **hyponitric** and **hydrofluoric acids.** Both are corrosive, the latter excessively so, affecting the eyes, air passages, and hands. One of the most terrible diseases is produced by inhaling the fumes of **phosphorus** in the process of making matches, namely, *necrosis* or death of portions of the jawbones. But by the substitution of amorphous phosphorus, which does not give off vapours as common phosphorus does, this dreadful disease has of late largely decreased. Photographers experience giddiness from fumes of **cyanide of potassium,** painters suffer from breathing **turpentine vapour,** brush-makers from **resinous vapours,** and workers in **paraffin** from its fumes.

SECTION IV.

REMOVAL OF WASTE AND IMPURITIES.

VENTILATION.

106. **What it is.**—The term ventilation, as usually employed, means the dilution or removal, by a proper supply of pure air, of the material given off from the lungs and skin of human beings, and of the products of combustion. In hospitals and similar places, it will include the removal of effluvia which proceeds from the persons and discharges of the sick.

Ventilation may be *natural* or *artificial*. The practice of natural ventilation consists in taking advantage of the operation of the law of the diffusion of gases,* in the movements of air, commonly called winds, and of the differences of weight and elasticity produced in masses of air by differences of temperature. In a room with comparatively solid walls, and few doors and windows, such diffusion is of a small amount, though through chinks and holes in imperfectly built premises,

* The law as to the rate of the diffusion of gases may be thus expressed : 'The relative diffusibilities of gases are inversely as the square root of their densities.' For example, the specific gravity of hydrogen is 1, and of carbon dioxide, 22. Now, out of 100 volumes of gas, there disappeared under experiment in 2 hours, 47 of hydrogen, and in 10 hours, 47 of CO_2. This proportion of 1· to 5 is nearly equal to the square roots of their densities, 1· to 22. When several different gases are admitted into the same space, each of them diffuses itself equally through the whole space as if the others were not there.

the air diffuses fast. The wind is a powerful ventilating agent. If it be allowed to pass freely through a room, the effect it produces is very great, depending of course on the rate of motion and the size of the aperture. Houses, therefore, where the air can pass through from front to back, are much more healthy than those which in some large towns are built back to back, a proceeding which, especially in the case of working-men's dwellings in narrow streets, ought to be discouraged. The objections to using natural ventilation by wind, are the variations in its velocity, and the difficulty of regulating its movements. If the velocity reaches five or six feet per second, and the air be cold, no one can bear it. This is a 'draught,' and gives cold, stiff neck, &c. The result generally is that the wind is excluded altogether, or if allowed to enter a room, it is badly distributed, merely forcing its way through the inclosed air like a foreign body, and escaping, it may be, by some opening with little or no mixing.

107. **Its Principle.**—All true methods of ventilation must proceed on one principle—an *incast* of fresh air, and an *outcast* of impure air. In a coal-mine we should speak of these as a *downcast* shaft and an *upcast* shaft. Few places are better ventilated than coal-pits, for a fresh supply of air is secured by burning a fire in the workings *between* the two shafts, thus causing the warmed light air to force its way out *up* one shaft, and the fresh cooler air to rush down the other to supply its place. The same principle may be illustrated in another way. If a piece of candle be placed in a flask and lighted, it will soon die out, from having consumed all the oxygen present; but if a piece of zinc be inserted in the neck so as to hang down a little distance into the

body of the flask, the candle will continue to burn, because an incast shaft and an outcast shaft have been formed, and the candle receives from the one a constant supply of fresh air, while the vitiated air passes away by the other. Unless these *two* points be secured, namely, an incast of fresh air and an outcast of impure air, there can be no true ventilation. Rooms of public assembly can often be seen supplied with numerous openings in the ceiling for the escape of heated foul air, and yet there is no real movement of the atmosphere, which becomes unhealthy and oppressive. It may be that crooked passages or staircases prevent fresh air from entering the room, and consequently there is no movement imparted to the inclosed air.

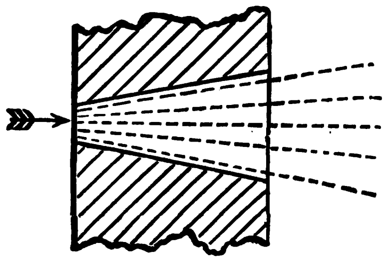
A great many devices have been hit upon of late years to ventilate rooms properly. The great desideratum is to supply the necessary fresh air in such a manner as not to cause a draught, but to disperse it unfelt throughout the room. Ellison's patent conical ventilating bricks secure this, and where practicable, their insertion in the walls of churches, schoolrooms, workrooms, lavatories, &c., is attended with good results. They may be used near the floor, which *theoretically* is the best place for the entry of cold air. *Practically*, the floor must be avoided as a means of ventilation, on account of the constant cold draughts experienced on it. Thus nearly all the systems of ventilation introduce the fresh air into the room by apertures made from 6 to 10 feet above the floor, that is, above the heads of the occupants. In Tobin's system, the air is admitted from an air brick or grating at the floor level, but its upward course is directed by its being carried up a cylindrical or rectangular tube, placed in the corner of the room. The column of

incoming air is thus sent up towards the ceiling, where it mixes with the warmer air and is diffused through the room. Harding's patent to a large extent combines the two foregoing arrangements. The outer air is introduced into a kind of box fixed to the inner wall of the rooms some eight feet from the floor. From this the air enters the room by numerous conical tubes set at acute angle with the wall, thus avoiding direct currents. The entering air is also filtered by being made to pass through several screens formed of miller's silk placed within the box.

NATURAL VENTILATION.

108. The **window** can be made of great use in ventilating a room. In summer, the window of every sitting-room should be open more or less throughout the day; in winter also, whenever the weather is fine enough, the window should be used, but so as to avoid cold draughts. This may be done best at all times by Hinckes Bird's plan, that is, by the insertion of a piece of wood about three or four inches high under the bottom of the window sash, taking care that it fits very tightly, and then pulling the sash down upon it; this throws the top of the bottom sash above the bottom of the top sash, and air is thus admitted above the heads of the persons in the room. The same thing may be arrived at by perforating with a long narrow slit the bottom of the upper sash. This slit should be covered by a tight-fitting metal plate, so that the entry of air may be stopped when it is desirable to do so. If a piece of perforated zinc be substituted for the wood at the bottom of the window, it will be found that a slight amount of air will be admitted, but owing to its very great division, it will cause but little draught.

The upper part of windows, especially large ones, in schools, &c., should be made to work on a hinge in a triangular framework, so that a current of air may be directed upwards. Wide projecting cornices just above such a window do harm by throwing the draught downwards. To avoid side draughts, the windows should be fitted with triangular side-pieces, if the window projects into the room. *Louvre ventilators* consist of a number of narrow pieces of glass arranged upwards like the laths of a Venetian blind, and which direct upwards the wind entering from the outside. Some are fixed, others are made to close. For shop and office windows, *Cooper's ventilators* are useful. Each consists of a circular disc of glass, with a number of slits in it. The disc revolves in a frame fitted to a pane of the window, and which is similarly perforated. When the holes of the disc are opposite to those of the window, air is admitted. The objection to their use is, that sometimes the air is so still that they cease to revolve, and at others the air enters in cold puffs. Many other adaptations of this principle are now obtainable.


Section of Ellison's Arrangement for Dispersing the Air.

Another method of introducing air into a sitting-room or office is by Ellison's patent radiator ventilator. It is composed of a flat disc, having behind it divisions placed crosswise, which, on closing the ventilator, slide into a box fixed in the wall about six feet from the floor. By means

of the four wedge-shaped compartments formed by the divisions, the incoming air is dispersed in all directions, and that so effectually that no draught is created.

109. The air of every room requires frequent flushing. If the room be unoccupied, the windows should be thrown wide open, and in this way a more thorough purification is effected than by any other means. The windows of bedrooms are, strange to say, often kept permanently shut. Sometimes they are not even made to open, at others they have become fast after painting, or from want of use. Such neglect cannot but be highly prejudicial to health. Of all places the bedroom needs its air flushing, and if the weather permit, every bedroom window should be opened widely at both top and bottom on the occupant's rising, so as to air the room and the bedding, which should be spread out. The bedroom window may be used for ventilation during the night. It is a popular delusion that night air is prejudicial to health. The fact is, that between 3 A.M. and 6 A.M. the outer air is healthier than at any other part of the day. Many persons constantly sleep with their bedroom windows open, and experience no bad effects even in the coldest part of the winter.

During the night, so much carbonic acid gas is given off by the sleepers, that the air becomes very unhealthy if no means of ventilation be used, and the occupants rise in the morning with headache and lassitude, because their blood has been only imperfectly oxygenised. Sleeping in badly ventilated bedrooms also lays the foundation of worse evils, notably consumption and scrofula. There is less danger from remaining in a stuffy, impure atmosphere during the day than during the night, for at night oxidation is less active, which

tends to the lowering of bodily temperature, and assimilation is more active, which favours the absorption of noxious vapours. If the bedroom be so small or low that opening the window causes a draught upon the sleepers, the door should be left ajar, and a window on the landing be left open.

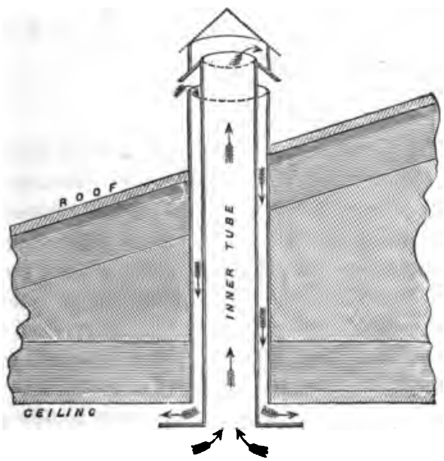
110. The most natural ventilator is the *chimney*, and yet how often is it stopped up by a chimney-board, bag of shavings, or straw. This is done by careful housewives to avoid the fall of soot and rain, but it is simply suicidal. The chimney forms a capital outcast shaft, and bedrooms where there is no fireplace, as is often the case in lodging-houses at watering-places, are dangerous places to sleep in. When a person is taken ill, the medical man often orders a fire to be made, though it may be warm weather. This is chiefly in order to ventilate the bedroom, as a small fire causes a draught and makes the air to ascend, thus carrying away any noxious smells. Occasionally chimneys provide an inlet of air, or in other words, become incast shafts. This results from an insufficient supply of fresh air at the base of the building by door or windows, and is the great cause of smoky chimneys.

Chimneys may be utilised for carrying off the heated and impure air of rooms by having openings made into them at a higher point than the fireplace. In large dormitories, simply taking out a brick from the chimney near the ceiling, will form a sufficient opening for the outward passage of the vitiated air. Dr Arnott was the first to use valves opening into chimneys for this purpose. His ventilator consists of a box for insertion into the chimney, which contains an iron plate moving on a pivot and opening towards the chimney flue, unless a down-draught takes place, and then the action

is reversed. The objection to its use is its noisiness, and the entrance of soot sometimes from the chimney. Boyle's patent valve is an improvement on this, as he hangs in it small talc plates at a certain angle. Falling by their own weight, they close the opening and prevent reflux, but a very slight pressure from without opens them. Better still than these valves is the presence of a second flue alongside the chimney, into which apertures from all the rooms in a house open, and which itself opens out above the roof. This, of course, must be put in at the time the house is built, but the valves can be put in at any time.

111. The *ceiling* or the *cornice* may be utilised for the purpose of removing foul air, and in some of our new public buildings this is done most effectively by means of wooden or zinc trunks above the ceiling, along which the heated air passes, being drawn up by the use of a revolving Archimedean screw, or some such ventilator as Howarth's placed on the roof. In large rooms like theatres, the sunlight forms a great means of ventilation, in that it draws up the air of the room to itself. It often, however, causes a draught. For public buildings, the use of *Boyle's air-pump ventilator* is preferable. This contrivance, by creating a partial vacuum, causes the impure air to rush up a central shaft and out at an opening. An improvement probably upon Boyle's apparatus is *Stevens's patent exhaust ventilator.* Instead of upright segments and guards, as in Boyle's apparatus, it is constructed on the horizontal principle. At whatever angle the wind strikes the cone, it creates a partial vacuum in the chamber, and under the hollow cap, thus securing a powerful upward current, and no down-blow. It also has the advantage of not holding snow that may drive into it.

112. For admitting fresh air into a room, perhaps the best method is by *Sheringham's valve.* In this the air passes through a perforated brick or iron plate, and is then directed upwards by a valved opening, which can be closed if necessary by a balanced weight. The size of the internal opening is, in the usual sized valve, 9 inches by 3 inches, consequently the area is 27 inches. These valves often become outlets. It depends, in fact, upon circumstances, whether they are inlets or outlets. Very little draught is, however, caused by them, unless with a high wind; on the whole, they are the best inlets of their kind. Dr Parkes thought that the best



Section of M'Kinnell's Ventilator.

plan for letting in pure air was by *M'Kinnell's circular tube.* This apparatus consists of two cylinders encircling one another—the inner one forms an outlet tube, and is protected on the outside by a hood or

cowl. The outer cylinder is the inlet tube, and the air that comes in by it is taken at a lower level than the top of the outlet tube. When the air enters the room, it is thrown up towards the ceiling, and then to the walls by a flange placed at the bottom of the inner tube. After having traversed the room and become fouled and heated, it passes to the inner tube, and is thus expelled. The movement of the air by this plan is almost imperceptible, and the apparatus is well adapted for square or round rooms, but not for rooms whose length is much disproportionate to their width.

There are many arrangements for artificial ventilation, but these will be discussed in a succeeding volume.

WASHING AND SOAP.

113. Perspiration is Nature's mode of getting rid of heat and dirt from the surface of the body. As soon as people become warm with exercise and work, perspiration pours out from their skins, and the abundance of the moisture softens and melts the adhesive dirt which may be upon them. But both the perspiration and the dirt are taken up by the clothes, and if these be changed, the most material part of the dirt is in this way got rid of, and thus uncleanly people do not suffer as much in their health as they would do, but for this influence of their clothes in absorbing and removing dirt and obstruction from the pores of the skin.

But these dirty clothes would soon become sources of serious mischief to health, if they were not removed and washed at frequent intervals, and clean clothes substituted in their place. Washing is at the

best a troublesome process. Because the excretion of the skin is of an oily adhesive nature, it necessitates the exertion of labour and skill, the use of heated water or steam and soap. One of the prime requisites is good soft water, but this is not enough; it must be assisted by soap. As oil and grease will not blend with water, a material which contains an alkali capable of dissolving grease must be used. Such a material is soap. Soda, potash, and pearl ash are joined in it with fatty acids. These dissolve in hot water, and mixing with the oily dirt in the clothes, saponize it so that it is dissolved out of the fabric, leaving it clean.

Flannels and all other woollen goods need very careful washing, owing to their peculiar texture. They must not be boiled or subjected to the action of soda. They should not be rubbed or wrung, but shaken vigorously in the water, squeezed, frequently rinsed, and then hung out to dry quickly. All this is to prevent their 'milling,' which they will do by careless washing. Coloured cotton goods should be rubbed (not boiled) and rinsed out in cold hard water, into which a little salt or alum has been dissolved, and then be made to dry quickly.

Dirt and grease from men's clothing may be effectually removed by using half a pint of ox gall to every two gallons of water. The mangling or pressing of such clothes needs to be done very carefully. A cashmere or merino dress may be made to look almost equal to new by being taken to pieces, washed in lukewarm soft water with little soap, then rinsed in a second water, and hung dripping on the line, *not* in the sun. When three parts dry, fold it and mangle it very carefully.

The labour of washing has been much reduced of

late by the invention of steam washers, such as those of Mitchell, Poole, Clark, Barrett & Russell, and others. In these, the clothes, being subjected to the power of steam in a confined vessel, are so permeated by it that the dirt is thoroughly loosened and rinses out easily, thus shortening the process of washing fully one-half, besides more effectually cleaning the clothes, than by the old ways of rubbing, scrubbing, peggying, and boiling.

Of the importance of washing the skin, hardly too much can be said; but this will be spoken of further on. The floors of rooms need to be well washed and scrubbed with soft soap; furniture should be washed and otherwise cleansed. Few things conduce more to the healthiness of a home than frequently washed floors, as in that way old dirt is prevented, and what might turn out to be poisonous germs are removed.

114. **Soap.**—The number of soaps offered to the public is great, and most of them are good. The great object is to find a soap that has a moderate quantity of alkali in it. Soap is really an alkaline stearate, that is, the alkali (soda, &c.) acts on the fatty or oily matter, and displacing the glycerine, unites with the stearin or palmitin, and forms a solid which is soap. In soft soap the alkali is potash. Such soap is not used for washing the skin, as it is too irritating.

Curd, or White Soap, is made by dissolving some washing-soda in water, and adding to it some slaked lime. The mixture is boiled and allowed to settle. The carbonic acid gas of the soda unites with the lime, forming whiting, which settles down and leaves the solution as soda lye. This is poured off and is again boiled, tallow or purified fat being then added to it. After some hours boiling, the fat is completely changed,

its glycerine being dissolved in the water, and its fatty acids unite with the soda as soap. It is then cast into moulds, dried, and cut into bars or pieces.

Mottled Soap has its characteristic appearance from the sprinkling of caustic soda on it when boiling. The soda sinking through its mass, leaves dark-coloured streaks in its track.

Yellow Soap and **Brown Windsor** have their colour imparted to them by the use of purified palm and other oils.

Fancy Toilet Soaps are usually made of good white soap remelted, perfumed, and sometimes coloured. Many soaps which have antiseptic, disinfecting, and other special qualities, such as coal-tar, vaseline, and sanitas, are now in the market for toilet and other purposes. The last is very pleasant, and exceedingly valuable as a disinfectant.

PARASITES AND THEIR REMOVAL.

115. As we have already seen, many diseases called zymotic are produced and spread by the presence in the blood and other fluids of the body of low forms of animal and vegetable life, introduced by germs which may be found in the air we breathe, the water we drink, and the food we eat.

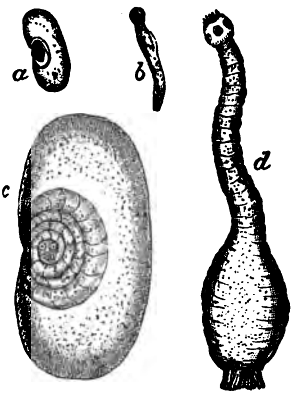
All these might with propriety be termed parasites inasmuch as they live and grow *upon* other organisms, but as we know so little about them, and they are mostly invisible to the naked eye, the name parasites is usually restricted to those larger forms of life which unhappily are very often present in the bodies of man and other animals, and whose presence becomes apparent in various ways. They often produce serious diseases, and even death, and it is therefore necessary

we should consider them with some amount of detail.

116. **Trichina spiralis.**—This is probably the worst parasite with which we are acquainted. Its life's first stage occurs in the flesh of the pig. When it is present, the lean of pork shows under the microscope small white specks, which on further examination are seen to be cavities technically called cysts, in which is coiled up a small fine thread-like worm. This worm has an enormous fecundity, producing from 10,000 to 12,000 eggs, but only *after* it has been received into the body of another animal termed its 'host.' In two days after a piece of infected flesh is swallowed by man, the worm becomes matured, and soon each female produces thousands of offspring. These worms are only $\frac{1}{25}$th of an inch in length, but are armed with terrible boring instruments. They do not remain in the alimentary canal, but bore their way through the viscera till they finally rest in the muscles. The disease developed during the migration of these multitudes of young trichinæ is known as trichinosis. Only a few cases have as yet occurred in England; but in Germany, where uncooked meat is often eaten, the disease is much more common. Dr Edward Smith says: 'Many people in Germany and elsewhere have had 50,000 worms in one inch of their flesh after eating diseased and uncooked meat. These minute thread-like creatures have penetrated everywhere, even into the eyes, and caused death.' A heat of 78° C. (140° F.) will destroy

The Worm coiled up in a Cyst.

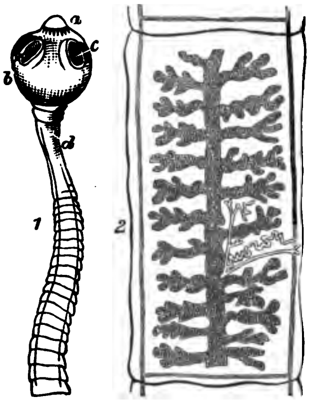
free trichinæ, but a much higher temperature is necessary to kill encysted trichinæ. Thorough cooking, therefore, is the only safeguard against these pests, and it is better to lose a little nourishment by well cooking meat, than risk such terrible results by eating it underdone. Trichinosis much resembles typhoid fever, and is attended by excessive pains in the limbs, &c. If the sufferer have strength to bear up till the parasites have reached the muscles, there is little doubt of recovery, for the trichinæ become encysted there as in the pig, undergo a change, and at length nothing remains of the cyst but a minute chalky speck.



a, a fully developed *Cysticercus cellulosæ* or *Measle*, taken from fresh pork (natural size); *b*, Cysticercus from salted pork; *c*, the same as *a*, magnified about 3 diameters; *d*, the same as *c*, with the head and body withdrawn from the caudal vesicle.

117. **Tænia solium.**—The tapeworm is a parasite far more common than the trichina. It is an instance of alternate generation, being in its first stage the measle or bladder worm of the pig (*Cysticercus cellulosæ*). If the eggs of the tapeworm voided by men and animals be swallowed by the pig, as is often the case, they give origin to imperfectly developed larvæ, which, like the trichinæ, bore their way to the muscles of the animal, where they settle down, inclosing themselves each in a little capsule or bladder (cyst). These cysts give the flesh a white speckled appearance, and it is known as measly pork. This will not be hurtful if subjected to thorough cooking,

as a temperature of 89° C. (160° F.) destroys the worm; but if such pork be taken raw or underdone, the parasite gets a new start in life. It develops into the tapeworm, so named from its ribbon or tape-like appearance, consisting of a minute head furnished with suckers and a ring of hooks, a neck consisting of small joints, and a body sometimes 15 feet in length, and consisting of large joints often to the number of 1200. It thrives in the intestines of man, producing new joints at its neck, and each joint containing very numerous eggs, each of which is capable of producing a new worm when placed in circumstances favourable to development. Another species (*Tænia mediocanellata*), which often attains a length of 20 to 30 feet, passes the first stage of its existence in the ox, producing measly beef.



1. Head, neck, and upper joints of *Tænia solium* magnified: *a*, the circle of hooks; *b* and *c*, two of the sucking discs; *d*, the neck.—2. One of the lower mature joints of the same, showing the organs distended with ova.

The presence of tapeworm is not attended by such serious symptoms or risk as trichinosis, but it often produces derangements of the stomach and bowels, which lay the foundation of ill-health. There may be disgust of food; an appetite sometimes voracious, at other times almost gone; fetid breath, emaciation, and nausea. There is another form of tænia which

gives rise to a distressing disease of the liver, known as 'hydatids.' The eggs of this tænia being voided by the dog (its host), are sometimes introduced into the body of man in the eating of badly cleansed vegetables—for example, celery, lettuce, &c. They then develop and pass to the liver, where they produce eggs in immense numbers; the liver becomes covered with little excrescences formed of them, and this is usually attended with fatal results. Other worms of the tænia type are found in various animals, but in this country probably there are no others parasitical in man than those just mentioned.

118. **The Fluke** (*Distoma hepaticum*).—This is a flat oval slug-like creature about half an inch long, which causes the 'rot' in sheep. It enters the animal from impure water, or the wet grass of low-lying pastures, and makes its way to the liver, into which it burrows, causing disease and death. Although these organisms may sometimes be seen in liver exposed for sale, there is no evidence of their having produced similar disease or death in man, though a similar parasite has been found (rarely) in his skin. Dr Parkes says that the embryos of *distoma* swim about in water, and their introduction into the body of man is thus possible.

119. **Worms.**—Children are very often subject to certain worms, which seem to be incident to their age, for they pass away, and are seldom found in adults. Thus there is the round worm (*Lumbricus*) about 12 inches long, and as thick as a goose quill, found in the stomach and intestines; *hæmatoid worms*, and *ascarides* or pin-worms, which inhabit the lowest part of the bowel. These all appear to be generated direct from ova received into the body, and cast off from the digestive canal of some one previously affected. The symptoms

present in children suffering from worms are emaciation and weakness, headache, sleeplessness, itching and picking of the nose, grinding of the teeth in sleep, distension of the abdomen, and general feverishness. These may be considered as including *all* to which human beings are liable in this country, though several other species are parasitical in man in other lands.

120. **Treatment.**—It is always best in these cases to secure medical advice. Worms in children will generally be easily got rid of by some vermifuge. As a rule, oil of turpentine, taken fasting, and followed by a dose of castor-oil, is sufficiently powerful to kill and expel any ordinary worm. But in cases of tapeworm it is often necessary to resort to a more powerful medicine—the extract of the male fern, which is taken in capsules. Careful scrutiny should be made that the head of the tapeworm has come away, else little if any good is done, the parasite growing rapidly again unless driven out by repeated doses.

There are parasites which, because they live *on* man, are termed *epizoa;* the others being called *entozoa*, as living *in* man. These are the result of filth and neglect, and should be unknown to all who value their health or have self-respect. As our workhouse and gaol officials too well know, the lowest classes of our population often swarm with living filth, and it becomes a great necessity that all persons should be extremely watchful against such infection, especially when travelling or living away from home.

121. **Ringworm** (*Trichophyton tonsurans*) and other skin diseases are due to the growth of *vegetable* parasites, which propagate very rapidly by means of minute spores. In ringworm occurring on the face, &c., there is an eruption on a slightly inflamed basis in the form of

small rings. Within, the skin at first looks healthy, but gradually becomes rough and scales off as the eruption dies away. *Tinea capitis*, or ringworm of the scalp, is a highly contagious and excessively obstinate complaint, often destroying the roots of the hair. The causes of this and similar skin diseases are want of cleanliness, keeping the head too warm, scrofulous disposition, coarse and indigestible food, close and filthy dwellings, and contagion. The greatest care should be taken to prevent this last, as the spores by which the ringworm-fungus spreads, can be carried about by hats, bonnets, gloves, towels, &c. Children affected should not be allowed to use the same towel or hair-brush that others use, or go to school to be among other children till the disease is quite cured. Ringworm is generally eradicated by the use of a lotion such as iodine, galls, or sulphurous acid, unless it be in the beard or hair on the head, when good medical treatment and the greatest cleanliness, with perseverance, are necessary.

DANGER OF DIRT.

122. The late Lord Palmerston said that dirt was simply matter in a wrong place. Its danger arises from the fact that it is the great vehicle by which disease germs are carried. There is often much dust, as we have seen, in the atmosphere, consisting largely of particles of clay, sand, dried mud, coal, soot, &c. It is always irritating to the throat and lungs, and generally disagreeable, but when mixed, as it usually is, with minute fragments of organic matter, such as dried horse litter, fragments of insects, and spores of microscopic plants, as well as corrupt matter from respiration, perspiration, and sickness, it often becomes an active and virulent agent in spreading disease. Dirt, then, is dangerous anywhere,

and in all places efforts should be made to reduce it to a minimum. Dung heaps, cinder heaps, and accumulations of rubbish should not be allowed in the vicinity of houses, and above all, no open cesspools, sump-holes, or filthy drains, for they help to spread low fever, typhoid fever, and other epidemics.

Dirt *in* the house is worse than dirt *out*, for there no diffusion of air serves to dilute the poison-bearing atmosphere. A home should always be neat and clean. Wretchedness, squalor, misery, waste, and want are usually the concomitants of dirt in the dwelling-house. Some neighbourhoods in our large towns, because of the dirty dwellings composing them, are marked on local maps as fever-beds, for it is known that it is in them that terrible epidemics begin, and find many victims. Dirty clothing and bodily uncleanness, which naturally follow from dirty houses and filthy surroundings, have been spoken of elsewhere in this work.

SECTION V.

SHELTER AND WARMING.

CLOTHING.

123. **Uses.**—The natural heat of the human body is 98°, and this temperature is very nearly constant—the same in winter as in summer, in Greenland as in Africa, in youth as in age. This heat, as we have seen, is the result of oxidation of carbonaceous material in the lungs and tissues. But the body is constantly losing heat, either by radiation, conduction, or perspiration. The skin radiates heat into the surrounding air, and the lungs

send out heated air; the skin, by conduction, warms the clothing of the body, and anything that comes in contact with itself. Also, by means of the excretion of the sudoriparous glands, much heat is carried off. If the outer air be colder than the body, as it usually is in our climate, radiation from the skin goes on freely into it. If the whole, or a large part, of the body, then, were exposed to the air, we should experience a sensation of cold—suffer from a chill—'catch cold,' as we say, lose our health, and in the end our lives. We therefore cover up all the body, except the face, with material to prevent this radiation. In the countries of the torrid zone, the atmosphere is often hotter than the human body, and in that case there arises a necessity to protect the skin from the outer heat; so loose, thin, and white clothing is worn to keep the body cool.

Clothing is also needed to protect parts of the body from injury; for example, shoes to cover the feet, and defend them from hard and sharp stones. Some things are not worn for warmth or protection, but merely for ornament. All civilised nations, too, clothe their bodies for the sake of propriety. The uses of clothing, then, are: (1) warmth, (2) protection, (3) ornament, (4) propriety.

124. All the materials of which clothing is made do not prevent the heat passing away from the body equally well. Some, like linen, allow heat to pass quickly through them, but others, like woollen cloth, only slowly. The first belong to the class of materials called *conductors* of heat, the second to the *non-conductors*. In very cold climates, the inhabitants wear clothing made of the very best non-conductors they can procure, such as the skins of animals covered with fur. In hot countries, on the contrary, the people wear loose and

thin conducting materials, as they only need clothing to protect the body from the outside heat. In our own country, it is often so cold in winter that we require a great increase in the quantity of our clothing, and it is sometimes so hot in summer, as to cause us to throw on all but light garments.

As children have a rapid circulation, they have also a rapid radiation. The amount of radiating surface is also much greater in them in proportion to their bulk than is the case with adults. From this it is seen that children need to be well clad, especially about the chest and neck. Exposure of the neck by the wearing of low-cut frocks, or of the arms by the use of excessively short sleeves, is fraught with evil. Bronchitis and other lung complaints are thus induced. The practice of swaddling very young children in very long clothes, three times the length of their body, and then 'shortening' them almost suddenly, when some three months old, is reprehensible, and often leads to cold and fatal results.

The mortality of infants, always great, is nearly doubled in winter, and it is said that one-sixth of the deaths of young children result from cold.

Aged persons make heat more slowly than young people, and circulation is much less active in them, so they need warm clothing, particularly in the matter of bedding. Indeed, all persons turned middle life had better err on the side of too much clothing, than too little. Thus the amount and nature of clothing must vary with the climate, the season of the year, and the age of the wearer.

125. **Clothing Materials.**—These are derived both from the animal and vegetable kingdom. The following table comprises all used in this country, tells the

source from which they are obtained, and the special uses to which they are put:

CLOTHING MATERIALS.

MATERIAL.	WHERE OBTAINED.	USE.
VEGETABLE.		
Linen...............	From fibres of stem of flax.	Underclothing, bed and table linen, &c.
Cotton............	Lining of pod of gossypium.	Shirting, prints, muslin, fustian, corduroy, &c.
Hemp.............	Fibres of stem of cannabis.	Harding — mixing with flax.
Jute................	Fibres of nettle-like plant, East Indies.	Mixing with hemp, silk, wool, &c.
India-rubber.....	Hardened juice of tree.	Overshoes, elastic web, waterproofing.
Gutta-percha.....	Hardened juice of tree.	Soles of shoes, &c.
Paper..............	Pulp of rags, both linen and cotton.	Collars and similar articles.
Straw..............	Dried stem of corn plant.	Bonnets and hats.
Rushes, grass, wood...........		Hats, chip-bonnets, &c.
ANIMAL.		
Silk................	Cocoon of silkworm.	Fine fabric for dresses, ribbons, velvets, &c.
Wool..............	Fine hair from sheep and similar animals—llama, alpaca, &c.	Cloth, worsted for dress fabrics.
Hair................	Covering of camel, goat, &c.	Camlets, coarse cloths, &c.
Leather...........	Skins of animals tanned.	Boots, belts, gloves, &c.
Furs................	Skins of animals with outer covering left on.	Tippets, hats, linings, &c.
Feathers..........	Outer covering of birds.	Trimming for hats, &c.
Horn, ivory, bone............	Hard parts of animals.	Buttons, &c.

VEGETABLE FABRICS.

126. **Linen**, used from very early times (see Genesis xli. 42), is not so largely used as formerly. It has gradually given way to cotton, which is both cheaper and warmer; but it is still much used for making those parts of underclothing which are seen, and more particularly those which are stiffened by starch, such as shirt-fronts, collars, and wrist-bands. This is because it can be made to take a whiter and more glossy appearance than cotton. It is also more durable. The fibre of linen is round and smooth, and is thus peculiarly agreeable to the skin, while the fibre of cotton is flat, twisted, and has sharp edges. Linen is a good conductor of heat, and consequently feels cold to the skin. It cannot hold as much moisture as cotton, and a person who has perspired freely would be more likely to catch cold from wearing a linen shirt than a cotton one, as the former would have a cold, clammy feeling. Because of its durability, it is much used for sheeting; and because, when pressed, it takes a bright, shining look, it is much used for table drapery.

127. **Cotton** is obtained from about twenty varieties of the plant gossypium, widely grown throughout the warm countries of the world, and its manufacture is England's greatest industry. When the cotton cloth leaves the factory, it is either designed to be *dyed*, for example, Turkey red, *bleached* till it is pure and white, or *printed* with some of those beautiful designs with which we are all familiar. When the natural colour of the raw material remains unchanged, the calico is said to be unbleached, and this is believed by most housewives to be more durable than the kind that has been whitened

by artificial means, and hence termed bleached. The unbleached is also a little cheaper, shows its make better, and will soon become white with washing, and will then retain its whiteness longer than the bleached kind. The bleaching of calico is brought about by subjecting the cloth to the action of solutions of soda, chloride of lime, and oil of vitriol, which removes the colour of the fibre, and leaves the cloth white, but which, to some slight extent, injures the fabric.

The list of cotton goods is almost endless, so many are the fabrics made of it, and so many are the varieties even of them—for example, there are at least twenty kinds of muslin alone. Fustian, velveteen, and moleskin are cotton cloths much used for making outer garments, and are considered warm and durable; corduroy, much worn by workmen, is a very strong cotton fabric, twilled and raised into ridges, making one of the most durable clothing materials known.

Calico is most extensively used now for shirting, and women and children's underclothing. It is moderately warm, and holds the moisture from the body well, without producing a feeling of chilliness.

128. **Hemp** and **jute** are not often used by themselves as clothing materials, but they are extensively mixed with other fibres, and jute is a great adulterant of silk on account of the gloss it can be made to take.

129. **India-rubber.**—The value of this consists in its being waterproof, elastic, and durable. It is much used in the manufacture of elastic web for boots and shoes, which has largely superseded the use of buttons and laces. The web is elastic enough to allow the foot to pass into the boot, but is also strong enough to grasp the foot when in, and act as a support to the ankle. Macintoshes are valuable as a protection against

wet. As they are not pervious to moisture, they will not allow the perspiration from the skin to pass away. They therefore produce great heat and a feeling of closeness, and should be taken off as soon as possible. For the same reason, goloshes often make the feet tender, and cause much pain.

130. **Gutta-percha.**—For clothing, this is used for the soles of shoes; such soles, being easily fastened to the shoe, are warm to the feet, and waterproof.

Of late years, **paper** has come largely into use for making collars, &c. This kind of paper is made from the finest linen or cotton rags, or from bleached raw cotton; and when used, is generally faced with very thin linen, glazed and highly pressed. As being cheap, clean-looking, and reducing the amount of washing in a family, such articles are of considerable value.

Straw hats afford an opportunity in summer of complying with one of the first laws of health, namely, 'keeping the head cool.'

ANIMAL FABRICS.

131. **Wool.**—This, though not the most extensively used, is without doubt our most important clothing material. Its non-conducting power, its ability to hold animal moisture, the fact that it can be made almost impervious to outside wet, and that it can be spun or otherwise made into so many and varied articles, all give it the place of first value in this respect. It is our oldest English manufacturing industry, and next to cotton, the most important. There are two great branches of the woollen manufacture; first, that of cloth, commonly called broadcloth; and second, that of worsted, or stuff. In the first, it passes through very many processes before it gets into the hands of the

tailor or mantle-maker. The most important of these processes, in its results, is 'fulling' or 'milling.' If we examine a fabric of wool by the aid of a magnifying glass, we shall find it is like all other hair in having scales on its surface, which lie one on the other like the slates of a roof.

The result is that when cloth is beaten by heavy wooden hammers called stocks, the hairs weld together or felt, as it is termed, and make the material to have a close texture and to be almost impervious to wet. The 'piece' is shortened and much narrowed by this fulling process.

Pure woollen cloth is an expensive but very durable fabric. Much cloth is now made that is a mixture of cotton and woollen, having a cotton warp and a woollen waft. Much inferior cloth is made from torn-up woollen rags. For outer wear by men in England, more woollen cloth is used than all other fabrics put together. Flannel is a woollen fabric of open and slight make; it is particularly useful for shirting, and for underclothing generally. Since its extensive use (either pure or as a union) for shirtmaking, rheumatism and similar complaints have considerably decreased.

Worsted is made of long wool, and of it a very large variety of materials is made, suitable for dresses, jackets, &c. Merino and imitation cashmere are excellent warm and durable materials for such dresses as are worn during the larger part of the year. Of wool many other things are made, such as blankets, shawls, rugs, and stockings.

Other kinds of woolly hair used for clothing purposes are: (1) *Alpaca*, which has a long, soft, and strong fibre, capable of taking a high finish; (2) *Mohair*, obtained from a species of Asiatic goat, is made into strong cloth,

shawls, plush, and braid; (3) *Cashmere*, the very fine hair of the Tibet goat, is made into rich and expensive shawls which bear its name. Of such hair as that of the camel, camlets and rugs are made.

132. **Silk** is not only the most beautiful and costly, but it is the strongest and most tenacious of textile fabrics. A single cocoon weighs only about three grains, but it consists of from 600 to 1000 feet of thread, $\frac{1}{2000}$ of an inch thick. The fibres are round like those of linen, but softer and very much smaller. Many of them are twisted together to form the silk as manufactured. Silk is a worse conductor than either cotton or linen, but being nearly always woven thin, it is light, cool, and pleasant for hot weather. *Satin* is silk cloth so prepared as to have a bright, smooth, and polished face. *Velvet* has a wonderful richness and softness of surface, obtained by a large number of threads standing out from the 'foundation,' and which form what is called the 'pile.' These threads have been woven as loops over wires, and afterwards cut very evenly. Other silk goods are crape, moire antique, brocade, plush, ribbons, &c.

133. **Leather** is the prepared skin of animals that has been subjected to the action of *tannin* in some form, or of oil, or both. The outer skin (the epidermis) will not tan, and is therefore taken off. Tannin is a substance widely diffused in certain parts of plants, but chiefly in gall-nuts and oak-bark. Formerly the English tanner used nothing but the latter, the skin being steeped in a strong solution of it in a pit. The process occupied a long time, but now much leather is quickly made by chemical processes. Tannin forms, with gelatine, an insoluble compound, and thus makes the skin stronger, tougher, almost imperishable, and able to resist the passage of water through it. The kind required

for shoe soles is simply pressed, but that for uppers must be curried, that is, subjected to the action of oil and grease rubbed in to make it flexible, and of soot and lampblack to colour it. Chamois, or wash leather, and leather for gloves are treated somewhat differently. Leather being impervious to moisture, is consequently not very healthy, and persons suffer much in their feet from it; the use of wash-leather under-clothing, which is also non-porous, is objectionable, because it keeps the skin hot and clammy. Perhaps no part of the body is used so badly as the foot in the matter of clothing. Boots are usually worn so *tight* that circulation is impeded, or so *ill shaped* that the toes are pinched, and corns and bunions produced, or the heel is so much elevated that strain and distortion of the muscles in front of the leg take place. The heel and sole should be broad, and the shape of the boot should coincide as near as possible with the ground plan of the foot.

134. **Furs.**—These are widely used in temperate and cold climates, (1) because they are good non-conductors; (2) because they are valuable and ornamental. The most valued are the sable, ermine, fox, marten, minx, beaver, and chinchilla. The fur-seal has been largely killed of late years for the sake of its thick, soft, and glossy fur, but real sealskin jackets are not so healthy as those made of the excellent manufactured imitation sealskin, because the former are so impervious to moisture, and often so heavy as to be fatiguing.

The use of **feathers** is almost entirely ornamental, save for bedding. Pillows made of down or feathers are grateful to the weary head, but beds made of some firmer material, for example, good wool flocks, are healthier than beds made of feathers.

HINTS ON CLOTHING.

135. **Sufficiency of Clothing for Infants and Adults.**—In addition to what has been already advanced, we remark that the amount of clothing must vary with the individual: (1) As regards the **state of health.** An active robust man, with a quick assimilation, requires less than a feeble one. Warm and sufficient clothing stands somewhat in the stead of food—the necessity for great oxidation being reduced, less carbonaceous food is required. (2) As regards **the season of the year,** although the difference is not so marked in this country between the necessities of summer and winter clothing, as in some neighbouring countries of the Continent, for example, France. This is owing to our very changeable climate, which necessitates changes of clothing sometimes on the same day. Many persons put on summer clothing far too soon, and continue it too late into the autumn. 'Never cast a clout till May is out,' is an old but truly suggestive proverb, and the cold mornings and evenings of September and October require us to be warmly clad if we would escape colds. But spring is the season that requires most attention in the matter of clothing, in order to guard against the sudden changes of temperature, and the cold east and north-east winds, then so prevalent. (3) As regards **age.** Reasons have been before given why youth and age require much warm clothing. Both infants and aged persons need great care, as the absence of a sufficient degree of heat often causes death. In reference to the aged especially, precaution should be taken to keep their extremities warm, for their circulation being feeble, and the production of heat small, the hands and feet

may become cold, and exhaustion leading to death may result. Flannel, or some other woollen clothing, is the only sufficient protection to the aged and the young, and much injury results from the absence of it. Young children should wear fine flannel nightgowns, as they are apt to be restless and to expose their bodies to cold during the night, and the aged would do well to wear them also. The middle-aged should wear calico, but if there be any tendency to rheumatism, the shoulders and arms should be protected by flannel. Woollen stockings, which may be got of various thicknesses, are especially desirable for people with cold feet, and are perhaps better than cotton ones for everybody.

With regard to **underclothing**, linen tends to give cold, calico absorbs moisture and is warm, woollen is the warmest of all. In cold weather there can be no doubt woollen is preferable, but in the heat of summer calico may be substituted; though even then, a thin woollen vest is a safe thing to wear, for our warm days often have chilly evenings. Fine Welsh flannel vests or singlets made to fit close to the body, are a good protection to the chest in cold weather. In warm weather a thinner wool, such as merino, may be substituted. Women would do well to wear more woollen next the skin than they often do; in fact, all persons should wear it from their infancy. With regard to **intermediate** clothing for outdoor use, woollen cloth, varying in thickness and colour between winter and summer, is the truest dress for men. For women, woollen worn in winter may be superseded by cotton (prints, muslins, &c.) and silk in summer. The tendency of our day is a good one, namely, to use woollen goods for outdoor wear by both sexes at all seasons—those for hot weather being exceedingly light and of open texture. With regard to **outer** clothing, men

not very actively engaged or travelling should be well wrapt in warm ulster or Scotch plaid shawl—women with warm shawl, ulster, or mantle. Clothing at night should not be heavy, but warm. A thick heavy cotton counterpane weighs down the body without giving much warmth, so that one feels unrefreshed in the morning. All coverings of the bed, except the sheets, should be of wool—the number of blankets varying with the weather and season. The young, old, and sick require more bedding than others, and in winter especially they need warm covering, particularly in the early morning, when the cold is greatest.

SECTION VI.

LOCAL CONDITIONS.

136. Health depends very much on the 'home and its surroundings,' by which is meant, the natural conditions among which it is placed, such as soil, climate, aspect, direction of winds, &c. The healthiness of a town or district is greatly influenced by local conditions; for example, all other things being equal, a town in an elevated position is always healthier than one in a low situation.

137. **Soil.**—Soils differ much in their capacity for holding water; but the drier the soil, the better it is for building purposes. **Gravel**, the looser **limestone formations**, **granitic rocks**, **chalk**, and in some cases **sand**, with permeable subsoil, are, in a hygienic sense, the best soils. All **clay** soils should be avoided; because, being impermeable, they hold the surface-water, and render the house damp and unwholesome. If, as will

frequently happen, clay cannot be avoided, it is specially necessary to have good trenching round the house, an impervious drainage system with a steep fall, and to build the foundations with tarred bricks, cement, or concrete. Sandy and gravel soils are sometimes rendered unsuitable by the occurrence of land-springs in them, particularly when the house is situated at the foot of a slope composed of pervious strata. Such a house should be trenched, and its site well drained, otherwise its foundations will be wet, and the moisture will rise through the bricks from course to course, till the living rooms are reached and rendered unhealthy. It would be well if all houses could be erected on virgin soil, the 'solid,' or 'God's ground,' as it is technically called; but in large towns many buildings are put up on *made* soils—that is, excavations and hollows are filled up with ashes, sweepings, contents of dust-bins, and such refuse, and on these houses are built. Danger to health arises from the gradual decay of the organic matters contained in such refuse, which renders the air in and about the houses impure. Such soils should never be built on till oxidation has destroyed the organic matter, and this takes a period of about five years.

138. Soil is an air carrier as well as a water carrier. Carbonic acid gas is found in all porous soils, and noxious gases from sewers, gas-mains, &c. will find their way into houses from considerable distances. Artificial warmth in a house causes an inflow of air from the soil, and it is important, therefore, that the ground-floors be rendered impervious. Living rooms not having cellars underneath them should have ventilating grates inserted in the walls, so as to have a current of air passing under them to prevent the accumulation of bad gases, and also

dry-rot in the woodwork. Another danger arising from porous soils is, that they allow of sewage matter passing through them from neighbouring cesspools, ditches, and dung-heaps. In this way the water supply from surface wells is constantly being polluted, causing the frequent occurrence of typhoid fever, diphtheria, sore throat, and diarrhœa. In many country places more care should therefore be exercised in the selection of a spot where to sink a well than is generally the case at present. The diseases consequent upon damp houses or situations are consumption, rheumatism, catarrh, and neuralgia. Ague, which was formerly common in the marshy districts of England like Cambridgeshire, has now almost entirely disappeared.

139. **Drainage of the Soil.**—This *must* be done, and may be done in several ways. The subsoil can be drained either by utilising the ordinary sewers for the purpose, in which case they must be penetrable by the ground-water, or it may be done by a separate system of pervious drains, made of bricks or drain-pipes. To the first plan there is the objection, that if the sewer gets full, its contents soak into the surrounding soil, and give off offensive emanations. The second plan is therefore preferable, but care should be used to provide a good fall. Surface drains to carry off the water direct from heavy rains greatly help to keep the soil dry.

140. **Aspect.**—Sunlight and warmth are important factors in promoting health; therefore the rooms where people chiefly reside should have a southern aspect wherever possible. It has been observed that sitting-rooms, studies, &c., into which no sunshine enters, are particularly favourable to the development of sore throat and bronchial affections in the persons who have to remain in such rooms. The next best aspect is westward, but

it is exposed to much rain, as in this country the prevailing wind is westerly. A northern aspect is always bleak and cold, but an eastern one is still worse, for the wind which blows from that quarter, especially in spring, is piercingly cold and dry, causing influenza and chest affections.

Detached houses, therefore, are best built with the chief front to the south, the next longest side to the west, the pantry, storeroom, &c., to the north, with the conveniences and outbuildings to the rear, and a blank gable to the east. Although trees planted around a house serve to break the force of the wind, yet, if quite close to it, their influence is on the whole bad, as they render it damp, and prevent the free access of sun and air. There should be an open space immediately around the house, which should be elevated enough to avoid draughts and smoky chimneys, so common when buildings overtower each other.

141. **Elevation.**—Observation confirmed by vital statistics shows that as we ascend from the sea-level the death-rate decreases, and that certain diseases rife on low ground diminish their intensity or cease altogether on high ground. Houses therefore built by a river-side or at the edge of a marsh are proverbially unhealthy; they are usually cold and damp, and the locality is subject to fogs, mists, and malaria, while but little air circulates about them. It follows, then, that elevated positions are the most healthy, and though more exposed to winds, are actually warmer than low-lying ground, for the air, becoming cooled by contact with the colder hill-side or slope, flows downwards. Thus frosts are often more intense at the bottom of a valley than on its slope. Not only should a house be built in a more or less elevated position, but it is well that it be

elevated somewhat above the level of the ground on which it is built. In a town, cottages are more healthy when the ground-floor is raised a few feet above the street, than when on a level with it. An elevated ground-floor gives an opportunity for ventilation which low-built houses do not possess.

142. **Hills.**—A hill gives the following advantages to dwellers on it: The air is cooler and more bracing; it is purer, and freer from dust and smoke; the humidity of the air is diminished, and the light is more intense. In many parts of England and Scotland, it is proved that lung diseases and rheumatism decrease as we leave the coast and proceed towards higher ground.

The climate of a **plain** is likely to be more extreme than that of the hill-side, as it is freely exposed to winds, rain, and snowstorms in winter, and to the hot rays of the sun in summer. **Valleys** enjoy variable climates. River valleys sometimes open out to favourable winds, and carry the beneficent influence of warm ocean currents and sea breezes far into the land. If they open in the direction of cold winds they are often unhealthy during certain parts of the year; while some, sheltered by their mountain sides, are most salubrious, and enjoy a delightful climate all the year round. Valleys are most healthy, however, when the confined atmosphere in them can be stirred and cleared by genial winds blowing through them.

143. **Mountain Ranges** act as great modifiers of climate. A warm wind coming against a mountain has to ascend before it can get over, and thus has its vapour condensed by the cold which this ascent and consequent expansion produces. If they interpose between the north wind and a plain, as in the case of the Alps and Northern Italy, they make the climate on their southern

slope to be milder and moister, but on their other side to be colder and drier in winter, owing to the absence of the warm and moist south wind; yet hotter in summer, owing to more intense radiation from the land, not moderated by any cool, moist oceanic wind.

144. **Distance from the Sea** is an important element in determining the climate of any locality. It is patent that towns on the coast usually experience greater regularity of temperature than inland districts, and this is owing to the modifying influence of the sea. Water has a greater capacity for heat than any other known substance. Its specific heat is four times greater than the substances forming the earth's crust.

145. **Importance of Specific Heat of Water.**—The great specific heat of water has a most important relation to the welfare of the living creatures on the globe. The sea, and other great beds of water, which spread over so large a portion of the earth, cannot in the hot months of the year become rapidly raised in temperature; in the cold seasons of the year, on the other hand, they cool slowly, and moreover, in cooling, evolve much heat, which equalises the temperature of the air as well as that of the land.

The difference between the temperature of two places in the same latitude, the one near the sea and the other remote from it, is very striking. Thus London and Moscow differ little in latitude, but the former never experiences the very severe weather common to the winters of the latter, and the same is true within less distances from the sea. Thus, although Paris is 2° 42′ of latitude farther south than London, it has not so mild a winter nor so cool a summer. The influence of the sea on climates has led to their classification as *oceanic*, *insular*, and *continental*. The first is the least liable to

violent changes of temperature, and for this, among other reasons, a sea voyage is usually beneficial to those suffering from weak lungs and pulmonary complaints generally. An insular climate is chiefly distinguished by experiencing a smaller difference between the minimum temperature of its winter and the maximum heat of its summer, than is experienced in the interior of great continents. The smaller the island, the nearer its climate approaches to oceanic. Much depends on the direction of the wind (see page 130). A continental climate is as a rule drier and more subject to extremes of temperature than either of the foregoing. One of the causes of England's moderate death-rate is her insular climate, and many of her watering-places have exceptionally low death-rates, proving their temperature to be well adapted to the prolonged life of man.

146. **Influence of Surrounding Objects.**—The healthiness or otherwise of any place of habitation is affected to an appreciable extent by the objects surrounding it. We have already spoken of the influence of the sea, of hill, plain, and valley. Besides these we may mention:

(1) *Cultivation of the Soil.*—Tilling and draining land causes a climate to become warmer, drier, and healthier; thus ague has almost entirely disappeared in consequence of the draining of the Fen district, and rheumatism and rheumatic gout have greatly decreased.

(2) *Forests* condense the atmospheric vapour, and by causing rains, feed springs. They also serve as shelter from winds, especially when situated on the slopes of hills or on plains. Cutting down forests has in some places caused colder winds to prevail, as in some of the cleared parts of America; in others, it has caused a scarcity of water, as in Tuscany. In Scotland, the

planting of trees has had good effect in some of the eastern counties; and in the Nile Valley (Lower Egypt), the same has led to the occurrence of rain showers. Forests are also believed to have a wholesome effect on the atmosphere in lessening carbonic acid, and some trees exercise a beneficial anti-miasmatic influence; for example, the pine, and notably the Eucalyptus.

(3) *Marshes and Bogs.*—The influence of these is uniformly unfavourable to health, as they generate fogs and mists, and give rise to malaria from the decay of organic matter in them.

(4) *Lakes.*—If these be large, they exert an influence like to the sea, only in a less degree. The surface-water of a deep lake amid hills, becoming cooled by radiation, sinks, and is replaced by warmer water from beneath. In this way, deep lakes become sources of heat in winter, and places on their shores do not experience the sharp frosts common to other low-lying positions. The lakes of North Russia, and others surrounded by flat land, are often the cause of dense fogs in their vicinity.

(5) *The Nature of the Soil.*—Chalk and other limestone formations are always warm and dry, and are considered very healthy. Sand is the same, as a rule. Towns and villages on these formations generally have low death-rates; for example, Carshalton in Surrey. Clay is always colder, and unless very well drained, becomes a source of damp and mist. The very colour of the soil has a hygienic value, as thereby will be reflected more or less of light and warmth into the atmosphere, or it may be an indication of the presence of much decaying organic matter.

(6) *The Presence of Streets, Buildings, Manufactories, High Chimneys, &c.*—The aggregation of buildings into

streets always moderates the cold in winter, and the reflection of heat from their walls increases the temperature of summer. Unfortunately, the emanations from many manufactories are often prejudicial to health; for example, dense smoke from forges, noxious gases from chemical works, and sickening smells from tan-yards and glue-works. High chimneys are also a source of danger during storms, unless protected by proper lightning conductors.

147. **Winds.**—Wind is air in motion, resulting from differences of temperature in the atmosphere, and consequent differences of pressure. Winds are capable of taking up the warmth of the land or water they pass over, and they also bring with them aqueous vapour, which they deposit in the form of rain, snow, dew, &c. If the winds blow over dry deserts or extensive barren tracts, they lose their moisture, and become the means of withering and blighting vegetation, and of causing disease to man and the lower animals. In this country, the north wind is cold, and brings frost and snow in winter; the east wind, which blows chiefly about the spring equinox, is dry and piercing, withering trees, and causing influenza, bronchitis, &c., in human beings, while the north-east winds are peculiarly keen, dry, and parching. The south wind is warm and genial; the west, or rather south-west winds, blowing, as they do, from the Atlantic, are warm and moist. Their vapour condenses on our western elevations, making the western counties of England (especially the north-western) to receive more rain than the eastern, and to be bright with verdure. As, according to the old proverb, 'the wind from the east is good for neither man nor beast,' we may expect that on the eastern side of Great Britain pulmonary complaints will be more common, especially in spring, than on the

western side of the island, and such is indeed the case. Winds blowing across the sea are not heated or cooled so rapidly as when they cross land, and therefore the climate of our watering-places and coasts is much more equable than of places more inland; and if such places on the coast be sheltered from the east and north winds, their climate is very mild, even in the middle of winter; for example, Ventnor and Torquay.

148. **Sea and Land Breezes.**—When the sun shines with equal force on coast-land and on the adjoining sea, the land becomes hotter than the water. The air above it ascends, and the heavier air from the sea rushes in. In the absence of the sun, the earth soon becomes the colder of the two, and the contrary movement goes on. Thus during the day there is a breeze from the sea to the land, and during night from the land to the sea. These breezes are felt on all sea-coasts during sunny weather, when not overborne by stronger winds.

SECTION VII.

PERSONAL HYGIENE.

149. Under this head are placed all those influences which go to modify the physical and mental powers of the individual, and which are the outcome of his own habits or of ancestral tendencies. The general state of the body, and the power to do work or resist disease, is spoken of as the *constitution*, which is either *inherited* or *acquired*. *Heredity* plays a most important part in determining constitution. 'Like father, like child,' is a common truism, and 'the sins of the fathers *are* visited upon the children even unto the third and fourth gener-

ation.' The tendency to gout, scrofula, consumption, and nervous disorders is transmittible from father to son, and many a child comes into the world with an enfeebled constitution inherited from those who have gone before him. Many a robust constitution is also turned into a feeble or delicate one by bad feeding, deficient exercise, the breathing of impure air, unhealthy occupation, or dissipated habits. It is equally true that a weak constitution may be strengthened by care and persevering attention to the laws of health; for example, a naturally weak muscular system may be made strong by a well-ordered course of gymnastic exercise. Without saying more about heredity, or considering the influence of age, sex, temperament, or idiosyncrasy, we pass on to habits.

HABITS.

150. **Habits** are the result of the oft-repeated practice of some act till an individual becomes so accustomed to it that it forms as it were part of himself—a sort of artificial necessity which it is hard to divest himself of. Habits may be important aids to the preservation of health, or they may be, on the other hand, predisposing causes of disease. It is therefore of prime importance to the well-being of all, that habits which are beneficial should be formed, and not such as are hurtful.

With respect to eating and drinking, regularity of meals, moderation of quantity, and rest after taking food, are good habits. Eating hastily, imperfectly chewing food, eating largely of condiments, and above all, the taking of large doses of stimulants either with or without food, are bad habits. So also is smoking by young persons. The late Dr Parkes says: 'Boys who smoke much are less disposed to bodily exertion.

Smoking interferes with the appetite, impairs bodily activity, and in some way must damage the circulation or the composition of the blood.' Dissipated habits, especially when formed in early manhood, generally undermine the constitution, and result in painful chronic diseases.

EXERCISE.

151. A certain amount of exercise for everybody is absolutely necessary for health; in fact *it* may be styled 'the first law of health.' It promotes the healthy action of all the excretory organs, especially the lungs, it leads to increased vigour of circulation, and is essential to the maintenance of a proper condition of all the tissues of the body. Parts grow and strengthen when properly exercised, but waste away when not sufficiently worked or when over-worked. Longfellow says of the village blacksmith:

> The muscles of his brawny arms
> Are strong as iron bands.

They are so because of the exercise they have had. The molecules of the muscle are rapidly oxidised when the muscle is in activity, and they are replaced by new materials from the arterial flow. The strength of the whole body and of each part is in proportion to the frequency of these nutritive changes. Exercise, then, does not wear out the muscles, but only increases their working power owing to the self-repairing power they possess. And this is true not only of the voluntary muscles, those we use in walking or working, but it is true of the involuntary, such as the muscles of the heart and bowels. The heart is invigorated by the improved action and power of other parts, and it is well known that the healthy action of the intestines largely depends

on voluntary exercise, especially walking; and cases of chronic constipation are often induced by too much sitting and too little walking. The value of exercise is also just as great in the case of the brain. Its powers of memory, observation, and judgment are greatly increased by careful cultivation and exercise. Proper intervals of rest must be allowed, and muscular development must not be interfered with; but if these points be secured, the brain is capable of great activity, especially if its occupation be varied.

152. **Forms of Exercise.**—Of all forms, walking is the most accessible, and much promotes bodily vigour in all who take it regularly. Many ladies of the upper classes are often weakly because they walk so little. Horse riding, hunting, and cycling are good for those who do not perform manual labour. Rapid passage through the air increases respiratory action, and many voluntary muscles are brought into play. Lawn tennis, cricket, and football are excellent games for outdoor exercise, as training many faculties beside the muscular; but to swimming and to rowing must be awarded the first place in giving exercise to muscle. In every town there should be a gymnasium at which exercises arranged on scientific principles might be engaged in.

153. **Effects of Exercise.**—These may be summed up as follows: (1) The size, strength, and activity of muscles are increased.

(2) Respiratory action is quickened, and the amount of air inspired increased; for example, the amount inspired lying down, equals 480 cubic inches per minute; the same walking at four miles per hour, 2400 cubic inches. Carbonic acid is more quickly got rid of, the capacity of the chest becomes greater, and consequently vital power is also greater.

(3) The skin increases its quantity of insensible perspiration, and generally becomes so active as to cause sensible perspiration.

(4) The heart's action and force are increased. If the exercise be hard and prolonged, it causes it to beat more slowly than its natural rate, and great harm is sometimes done in this way in boat-racing contests, foot races, &c.

(5) The heat of the body is made more equable. Cold feet often are made to glow by a brisk walk, and such a walk should be taken just before retiring to bed, if possible, by those who suffer from sleeplessness through cold feet. Exercise causes effective circulation of the blood, and such things as chilblains and dead fingers should disappear before regular exercise.

(6) The appetite is increased, digestion becomes more perfect, and assimilation of food more rapid.

(7) Muscular exercise indirectly improves the nervous system. It clears the brain, which also profits by the vigour gained by the whole system.

(8) Excretion of effete matter by the organs is increased, and the blood is cleared of material like urea, which, if retained, lays the foundation of serious disease.

Exercise, to be really valuable, must be systematic and regular, and be taken as far as possible in the open air. It should not be taken immediately after a meal, nor continued till exhaustion is experienced. A chill from profuse perspiration must strictly be guarded against.

REST.

154. Although the body is a working machine, it cannot be exercised without intermission. Repose naturally follows on exertion, whether muscular or mental. Rest is a necessity. Experience shows that

hard labour cannot be performed beyond four, or at the most five hours at a time, and the meal-hour for the operative becomes therefore a time of rest as well as of refreshment. After long-continued labour the muscles become fatigued, or the brain becomes dull. Rest restores both these to their normal strength and elasticity. Rest may be *partial*—one part of the body that has been previously working, is allowed to rest, while another that has been hitherto inactive is roused to work. Thus the student takes a walk, and the hard worker reads light literature. This is the principle of all true recreation, namely, to relieve the faculties that have been on the stretch, and to bring into exercise those that have been unemployed. In these days of concentrated activity, it is well to have an *annual rest* if possible, and to combine with it change of scene and air at the seaside, or amidst country scenes.

But the truest rest is *total rest*, 'tired Nature's sweet restorer, balmy sleep.' This must be had by all persons nightly if health is to be maintained. Sleeplessness is one of the first symptoms of cerebral disturbance and incipient insanity. How sleep is brought about is not yet made plain. It possibly results from an anæmic condition of the brain, but however produced, the value of sound, healthy sleep cannot be overrated. 'He that sleeps, feeds,' is an old axiom, and it is very true, for the tissues receive their greatest amount of building up during sleep—assimilation is then more energetic. But sleep, to be of greatest value, must be had under healthy conditions, namely, the bedroom should be sufficiently large and airy, and kept perfectly dark during the night, the bed moderately hard and firm, the circulation of air not impeded by curtains—the time of retiring should be

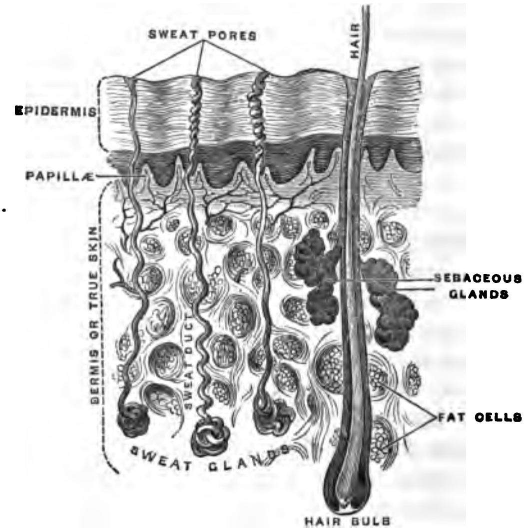
a regular one, and the last meal a light one. The amount of sleep needed varies with the individual, seven hours being a general amount for all adults, but the young and old require much more. Women require rather more than men, and the intellectual worker more than the manual labourer.

The taking of narcotics or medicines of any kind to induce sleep should be most scrupulously avoided, as the doses require to be continually increased, and at last the nervous system is completely ruined.

CLEANLINESS.

155. **Attention to the Action of the Skin and Bowels.**—Attention to the state of the skin is greatly to be enforced on all. The skin is a most active excretory organ, having opening on to its surface some five or six million pores, each being the end of a small tube which communicates with a gland placed in the deeper part of the skin. These are termed **sudoriparous glands**, and their function is to separate from the blood supplied to them, water, salt, some fatty acids, and a little urea, which they pour out on to the surface. This secretion is named perspiration or sweat, and is sent out winter and summer, day and night, and under all healthy conditions of body. The amount varies very much according to exertion, outer temperature, and kind of food taken. When not visible to the eye, it is called insensible perspiration, and the amount of this excreted from the body of an adult is, in the twenty-four hours, 10,000 grains or $1\frac{3}{7}$ pounds avoirdupois. It evaporates into the air, or is absorbed into the clothing. If this excretion be hindered by dirty condition of skin, the temperature of the body is lowered, and disease is engendered. A dirty skin is

a fruitful source of fever, congestion, and bronchial diseases, to say nothing of diseases of the skin itself. Many illnesses are warded off by a warm bath, or the taking of some medicine to excite the skin to increased



Vertical Section of Skin.

action, thus proving the importance of the healthy action of this organ. Another reason for cleanliness of the skin is to be found in the fact of its possessing a second series of glands, called **sebaceous glands**, which secrete an oily suety kind of substance for the purpose of rendering the skin moist and elastic. The openings of these glands are often closed up by dirt, and give to the skin the appearance of having little black spots on it. Pimples on the face are generally due to obstruction of these glands, and acne, an inflammatory

condition of the skin, is often a result of the same cause. The material which these glands secrete needs to be removed by *warm* baths and the use of soap, as, if allowed to remain, it becomes rancid and offensive, and mats together the scales of the epidermis. A third reason for cleanliness of the skin is to be found in this, namely, that the epidermis or scarf skin is always having its scales renewed—the lower layers are continually growing and pushing upwards, and the top layers are as constantly dying away and being shed. If these scales be not removed from the skin by periodical washing, there comes to be an accumulation of effete matter on it composed of perspiratory excretion, of sebaceous matter, and of dead epidermis. This cannot but be harmful, and leads to impaired sensibility of the skin; the tendency to take cold is increased, the blood is rendered less pure, and the tendency to cutaneous diseases is favoured. Not only, then, should the face and hands be cleansed from the impurities which cling to them from the atmosphere, work, &c., but the whole skin, by warm and other baths, should be subjected to regular cleansing processes.

156. **Baths and Bathing.**—The primary object of bathing is cleanliness; other objects are invigoration of body and the pleasure derived from it. For the man of sedentary habits, baths are highly necessary. The skin, when actively employed, cleanses itself, so the working-man who perspires freely may be as clean with his weekly bath as the intellectual worker with his daily bath. Every person should have a warm bath at least once a week to remove sebaceous matter, &c., but there is no bath that will open pores, remove dirt from sebaceous openings, and dead epidermic scales, like the Turkish bath. On account, however, of the strain

it exerts on the heart and circulatory system generally, it should not be first taken except under medical permission.

Children especially should be kept clean. Many an illness might be avoided if the child, when complaining of headache or want of appetite, were subjected to a warm bath. Cleanliness of the person involves attention to the hair, which should be well and constantly brushed; to the teeth, which should be brushed or washed with salt and water after every meal; to the nails, which should be kept pared and cleaned; and to the apparel, particularly that worn next the skin. This last should be renewed weekly, and outer flannel shirts should be changed frequently; because they do not show the dirt as much as cotton shirts, they are often worn for too long a time. Cleanliness of the house is also important as a means of health. Dust allowed to accumulate often attracts to itself organisms which are concerned in spreading zymotic diseases. Houses should be thoroughly overhauled twice a year, the paint washed, the ceilings whitewashed, and the carpets taken up and well shaken. Especially is this necessary in the case of cottage homes where cooking and washing go on in the same room in which the occupants live. An examination of the walls would often reveal the presence of fungi and other organisms concerned in the spread of disease.

157. We have spoken about the attention necessary to be paid to the action of the skin. We must now notice the importance of attending to the right action of the bowels. About 5 per cent. of the annual premature deaths (that is, all deaths not proceeding from old age) result from diseases of the digestive organs, and the suffering that proceeds from them is in far greater

ratio. It is intended by nature that the undigested portions of the food and the surplusage of the food shall be got rid of by the bowels. But sometimes owing to habit of body, want of exercise, much sitting, or unsuitable food, the bowels are constipated. They then retain a good deal of morbid matter in the body, which is reabsorbed into the blood-vessels and lymphatics, thus poisoning the blood, and laying the person open to easy infection, ulcerations, skin diseases, gout, &c. Regularity of the action of the bowels should be aimed at, and constipation avoided by the taking of exercise, the use of ripe or stewed fruits, especially figs, and of bread made from whole wheat-meal. A glass of cold water taken before breakfast, and an orange or two soon after, is an excellent mode of treatment for chronic constipation. Painful stools may be avoided by taking warm sitz baths.

SECTION VIII.

TREATMENT OF SLIGHT WOUNDS, ACCIDENTS, &c.

158. All persons are liable to accidents at any time, and it is therefore highly important that every one should know what is best to be done in cases of emergency, where surgical aid cannot at once be obtained.

159. **Cuts.**—These may be serious or otherwise. In the case of a slight ordinary wound, let cold water flow over it freely, and afterwards wipe the wounded place with a piece of clean linen, in order to remove dirt or foreign matter. If the cut is sufficiently large to need it, bring the cut edges together, and hold them in their

places with strips of diachylon or court-plaster, put on diagonally. Wrap up the part in a linen bandage to preserve it from the action of the air, and to prevent dirt entering it. If the flesh be healthy, it will soon heal, for nature has wonderful repairing powers. If the cut be a serious one, a much different course must be followed. The first thing is to determine whether it is an *artery* or a *vein* that is cut. **Arteries** are blood-vessels as a rule deep-seated in the flesh; the blood in them is flowing *from* the heart, is pure and bright red, and having the propelling power of the heart behind it, issues from them, when cut, in jerks. The **veins** are blood-vessels mostly near the surface, as may easily be seen on the back of the hands, &c. The blood in them is flowing *towards* the heart, and is of a darker colour than that in the arteries, and flows from a wound in a continuous stream. Loss of blood is at all times a serious matter, and especially so in the case of a cut artery, persons often rapidly bleeding to death. Bleeding may generally be stopped by pressure, but it must be rightly applied. If it be a vein that is cut in a limb, a ligature must be passed tightly round the limb *below* the wound; if an artery, then the ligature must be placed *above* the wound, so as to intercept the flow of blood from the heart.

Sometimes cases occur of persons being severely cut when at some distance from any place where medical help can be obtained, and it may be necessary for persons on the spot to bring *great* pressure to bear in order to stop the bleeding. A doctor would do this by means of a tourniquet (see fig.), which consists of a strong but soft leathern band, fitted with a metal plate pressed down by a screw. In the absence of this appliance, a substitute may be improvised thus: for the

leathern belt substitute a large folded (silk) handkerchief, and in place of the metal plate use a piece of wood, a stone, or any flat hard substance that may be at hand. This latter being placed above or below the wound, immediately over the blood-vessel, as before explained, and held down firmly, the handkerchief must be tightly tied over it, and a second knot be formed, into which, by way of a screw, a piece of wood like a stout penholder should be inserted, and twisted round till the bandage is as tight as can be borne by the patient. In this way little blood need be lost, even though the injured person may have to travel a good way to reach the surgery of some medical man. If the bleeding be from the scalp, face, or any part where a ligature cannot be used, a pad made of some soft substance should be put upon the wound, and pressed tightly down by the hand or tied tightly over it. If it be an abscess or ulcer from which the flow of blood comes, it should have applied to it cotton, wool, linen rag, &c., dipped in a styptic solution, such as tincture of steel. If the latter be not at hand, the same, made into a compress and dipped in cold water, should be tightly bound over the place.

Common Tourniquet.

160. **Varicose Veins.**—These are dilated knotted

veins, which usually appear on the legs of persons who stand a great deal, but they may arise from other causes. Being so near the surface, they are liable to injury, and the bursting or cutting of them is attended with great danger. If, however, one be burst, a ligature must be used as above, and the services of a medical man be called into request as speedily as possible.

Bleeding from the Nose may be stopped by using powdered galls as snuff, the nostril having been previously cleared by blowing down it. Sometimes Nature relieves herself in this way, and serious brain and other affections are avoided; but if the bleeding be often and copious, its weakening effect is so great as to necessitate taking means to stop it. Occasionally, persons suffer much from *bleeding* from the socket of an extracted tooth. This may be stopped by filling the hole with a piece of lint dipped in tincture of iron, the lint being held down with a piece of cork placed on the top of it, the jaws being firmly pressed together.

Bleeding from the Lungs or Stomach, unless slight, is attended with extreme danger. In slight cases, one drop of elixir of vitriol or a teaspoonful of vinegar taken in a little water every two or three minutes, will probably stop the hæmorrhage; or ice pills should be swallowed, and a dose of astringent mixture, like a teaspoonful of tincture of iron, be administered in a glass of iced water. In graver cases a doctor should be sent for at once.

161. **Bruises.**—A bruise is an injury done to the capillaries of the skin or underlying tissue. If a part of the body be bruised, it becomes swollen and discoloured. This is owing to the large escape of blood (by doctors called extravasation) from the capillaries into the surrounding tissues. The part, therefore, should be kept at rest, and be kept cool by the application of cold water

or a piece of ice covered with thin linen and used as a pad. For black eyes, the application of a piece of raw beef is an old-fashioned and successful remedy; but when this cannot be obtained, a piece of cold stone will answer nearly as well.

162. **Burns.**—The danger from these varies according to the extent of surface burned and the depth of the burn. It is held as an axiom among medical men that if more than one-fifth of the total surface area of the body be injured, recovery is hopeless; but it should be remembered that a burn on the trunk is much more dangerous than one of equal size on a limb, as serious inflammation, &c., may be set up in the vital organs beneath. Absence of pain is a bad sign in a case of burning, as it shows that the part has been altogether destroyed. Many persons die of the shock or collapse consequent upon the accident, rather than from the actual burn.

The first thing to be done is to relieve the sufferer by applying to the injured part linseed or sweet oil. The next thing is to bind over the burn some cotton wool in order to exclude the air, and generally nothing more is required. Sometimes the cotton wool may be soaked in a mixture of lime water and linseed oil in equal parts, and covered with oiled skin or gutta-percha tissue, over which a bandage is tied.

Accidents from Fire are very numerous, and in no case is presence of mind more necessary. A person whose clothes have caught fire should be rolled instantly, lying in a horizontal position, in a carpet, rug, or some woollen material, the head only being left exposed. The fire being put out, the clothing in contact with the part burned should be carefully removed by freely cutting it off, so as to avoid injuring the skin by dragging it over the injured part.

Scalds are simply burns resulting from heated liquids. Those produced by hot fat or milk are more severe than those produced by water. The treatment is the same as in the case of burns.

FITS.

163. The two commonest kinds of these are **fainting** and **epileptic** fits. A fainting fit arises from sudden failure of the heart's action. It is most common in young adults, especially young women. It is an indication of general debility or poorness of blood. Sometimes it follows upon unusual fatigue or long abstinence from food, or it may be brought about by some sudden impression on the nervous system, for example, sudden joy, sorrow, or fright. To prevent the occurrence of fainting fits, the general health must be attended to—a generous diet, outdoor exercise, cold sponge baths or sea-bathing must be had where possible, constipation must be guarded against, and late hours avoided.

Treatment.—Lay the patient flat on the back with the head low, loosen the cravat, collar, shirt neck, and any tight-fitting part of the dress, sprinkle cold water on the face, apply smelling-salts to the nose, and give stimulants or sal-volatile in small doses as soon as the person has sufficiently recovered consciousness to swallow. If the fit occur in a crowded room, close-heated church, or a theatre, the patient should be removed to the fresh air at once, and lookers-on should not crowd round, which was a common fault, it seems, even in Shakspeare's day, for he says in *Measure for Measure:*

> So play the foolish throngs with one who swoons;
> Come all to help him, and so stop the air
> By which he should revive.

164. **Epileptic Fits.**—This terrible visitation, commonly called falling sickness, is of so startling and sudden a nature, that we need not wonder that in all ages this sickness has been viewed with great terror. The fit comes on suddenly. In a moment, with a loud cry or groan, the patient falls struggling, foaming, and insensible upon the earth, a choking sound is heard in the windpipe, and for a short time he appears to be at the point of death. In a little while these alarming symptoms abate, and at length cease, leaving the patient heavy, exhausted, and stupid. After an interval, this too passes away, and he is to all appearance again perfectly well. Very little is known about the causes of epilepsy. It is believed to be frequently hereditary, and to result from nervous shock, long-continued anxiety, &c. Little help can be rendered by onlookers further than to loosen the collar, necktie, &c., and to prevent the patient from injuring himself by striking the floor or furniture. A piece of cork or india-rubber should be placed between the teeth in order to prevent the tongue being bitten. A course of careful medical treatment, together with attention to diet and exercise, will often result in a complete cure after a time. There is no disease more frequently feigned than epilepsy, particularly in crowded streets, for the purpose of obtaining money from the bystanders; but impostors may readily be detected, as they never fall so as to hurt themselves, they over-act the convulsions, and if their eyeballs be touched, they flinch.

165. **Hysterical Fits** are mostly confined to women of strong emotional temperament. They consist of paroxysms of great excitement, accompanied by cries, screams, and throwing the arms about in a disorderly manner. Unconsciousness is seldom complete, the

tongue is not often bitten, and though the attack is followed by exhaustion, it is never by stupor. By these signs, hysteria may be distinguished from epilepsy. The determining cause of an outburst is usually some mental or moral disturbance or trivial circumstance, which, coming upon the individual by surprise, overcomes all self-restraint. During a fit of hysteria, there is very little to be done; the patient is in no danger, and will come round if let alone. The dress should be loosened, she should have plenty of fresh air, and cold water should be applied somewhat freely to the face and hands.

166. **Convulsions** are very common in children, and few mothers of large families have been without experience of these fits. They usually indicate one of two things—either that the child is of a weakly constitution, or that there is some cause of irritation in the child's body which is setting up the convulsions. In the former case, it is probably an accompaniment of rickets, or of a strong hereditary tendency to such nervous complaints as neuralgia and epilepsy. But it is far more likely that the convulsion results from the second cause, the irritation being from teething, worms, or indigestion. Young children are often most unsuitably fed with pastry and starchy food, and this produces serious derangement of the digestive organs. Great care should therefore be exercised by mothers as to the feeding of young children, especially just after they leave the breast.

Treatment.—When the fits proceed from constitutional weakness, the advice and continued attention of a medical man is necessary, if the child is ever to grow out of them. With reference to those which proceed from constitutional derangement, if the cause can be

detected, every effort must be made to remove it. The bowels must be cleared by a gentle purgative, or the stomach relieved by an emetic, or if there be real necessity for it, the gums should be lanced. A hot bath is often of great service, but leeches and blisters should never be used, as they weaken the child and increase the danger. Convulsions prove fatal by the exhaustion they cause, and therefore it is of first importance that the child's strength should be kept up. This may be done by giving it nourishing food, as milk, weak gruel, and beef-tea. Next in importance is to calm the nervous system, and if possible to get the child to sleep.

SUFFOCATION.

167. **Suffocation**, or asphyxia, may be a result of various diseases, or of accident. Sometimes it is a method of suicide or murder. Death is brought about by the stoppage of breathing, and subsequently of the heart's action. In the case of the breathing of poisonous gases, death results because the blood is deprived of its needed oxygen—it is a case of oxygen starvation. Persons found hanging should immediately be cut down and laid on the floor. In treating all cases of suffocation or strangulation, three things should be aimed at—namely, to restore breathing, to set the circulation going, and to preserve the normal heat of the body. Therefore, artificial respiration must be practised, warm applications, such as hot bricks or the oven-plate wrapped in woollen, must be made to the sides or under the armpits, and friction of the extremities must be persevered in for a considerable time. Galvanic shocks, if available, will aid in stimulating the heart's action, and restoring circulation.

Sometimes choking is produced, especially in the case of children, by hard foreign substances being pushed or dropped into the throat. In these cases, the substance must be removed by the finger if able to be reached. If this cannot be done, the services of a medical man must be secured at once, who may have to resort to tracheotomy. Smart blows on the back of the sufferer, especially if the head be inclined forward and downward, will often dislodge the substance.

168. **Drowning** is only an instance of suffocation. The drowned person dies because he is deprived of *air*. As many lives are sacrificed in this way every year, particularly in the bathing season, it is highly important to know what to do to restore the apparently drowned. The Royal Humane Society issues the following instructions :

Send immediately for medical assistance, blankets, and dry clothing, but proceed to treat the patient *instantly* on the spot, in the open air, with the face downward, whether on shore or afloat; exposing the face, neck, and chest to the wind, except in severe weather, and removing all tight clothing from the neck and chest, especially the braces.

The points to be aimed at are—first and *immediately*, the RESTORATION OF BREATHING; and secondly, after breathing is restored, the PROMOTION OF WARMTH AND CIRCULATION.

The efforts to *restore Breathing* must be commenced immediately and energetically, and persevered in for one or two hours, or until a medical man has pronounced that life is extinct. Efforts to promote *Warmth* and *Circulation*, beyond removing the wet clothes and drying the skin, must not be made until the first appearance of natural breathing; for if circulation of the blood be induced before breathing has recommenced, the restoration to life is endangered.

TO RESTORE BREATHING.

TO CLEAR THE THROAT.—Place the patient on the floor or ground with the face downwards, and one of the arms under the forehead, in which position all fluids will more readily escape by

the mouth, and the tongue itself will fall forward, leaving the entrance into the windpipe free. Assist this operation by wiping and cleansing the mouth.

If satisfactory breathing commences, use the treatment described below to promote warmth. If there be only slight breathing—or no breathing—or if the breathing fail, then—

TO EXCITE BREATHING.—Turn the patient well and instantly on the side, supporting the head, and excite the nostrils with snuff, hartshorn, and smelling salts, or tickle the throat with a feather, &c., if they are at hand. Rub the chest and face warm, and dash cold water, or cold and hot water alternately, on them. If there be no success, lose not a moment, but instantly—

TO IMITATE BREATHING—Replace the patient on the face, raising and supporting the chest well on a folded coat or other article of dress. Turn the body very gently on the side and a little beyond, and then briskly on the face, back again, repeating these measures cautiously, efficiently, and perseveringly, about fifteen times in the minute, or once every four or five seconds, occasionally varying the side.

(By placing the patient on the chest, the weight of the body forces the air out; when turned on the side, this pressure is removed, and air enters the chest.)

On each occasion that the body is replaced on the face, make uniform but efficient pressure with brisk movement, on the back between and below the shoulder-blades or bones on each side, removing the pressure immediately before turning the body on the side. During the whole of the operations, let one person attend solely to the movements of the head and of the arm placed under it.

(The first measure increases the expiration—the second commences inspiration.) The Result is *Respiration* or *Natural Breathing*; and if not too late, *Life*.

Whilst the above operations are being proceeded with, dry the hands and feet, and as soon as dry clothing or blankets can be procured, strip the body, and cover or gradually reclothe it, but taking care not to interfere with the efforts to restore breathing.

POISONINGS.

169. Poisons may be divided according to their effects into three classes: (1) Irritants; (2) Narcotics; (3) Narcotico-irritants. Those of the first class act upon the alimentary canal, irritating its mucous lining, producing a sense of burning and constriction in the throat, violent pain in stomach, vomiting, purging, &c. Those of the second class affect the brain and nervous system, causing delirium, convulsions, stupor, coma, &c. The third class, as the name implies, have both an irritant and narcotic action.

If a person previously quite well begin with vomiting or purging after eating or drinking, or becomes drowsy and confused, it is highly probable that he has partaken of poison. The nearest medical man should be immediately sent for, and be also informed of the symptoms and their supposed cause, in order that he may come prepared. As, however, loss of time may entail loss of life, it is well to know what treatment to adopt as most likely to secure the patient's welfare. An emetic should be given, and vomiting encouraged by draughts of warm water.* Fortunately, the antidotes to many dangerous poisons are articles of daily use, and consequently always at hand.

The following table shows the poisons, the symptoms they produce, and the simple antidotes that may be used:

* Emetics may be quickly made in various ways. A dessert-spoonful of mustard stirred up in a cupful of warm water; a tablespoonful of common salt, or of powdered ipecacuanha, or as much tartar-emetic as can be placed on a threepenny piece, similarly mixed, are good emetics.

Poisons.	Symptoms.	Antidotes and Treatment.
Irritants.		
Sulphuric, nitric, and muriatic acids.	Intense pain in throat and stomach, with vomiting of blood and matter. Skin of mouth and lips blackened in patches.	Chalk and water, and carbonate of soda or potash. In the absence of these, pipe-clay, whiting, plaster off the walls dissolved, or soap-suds, should be given immediately.
Oxalic acid.	Similar to the above, together with cold sweats and stupor.	Chalk, lime water, magnesia, and oil; but *not* soda or potash.
Ammonia, pearl-ash.	Burning sensation in throat and stomach, cold and clammy skin, diarrhœa, or severe colic. Chocolate-coloured patches on lips, tongue, and throat.	Vinegar and water, orange or lime juice.
Antimony (tartar emetic).	Extreme prostration, cold skin, sunken eyes, pain in stomach, profuse diarrhœa, and much vomiting.	Decoction of nut-galls or oak bark, strong coffee, or green tea.
Arsenic.	Burning sensation in throat and stomach, followed by vomiting of brownish matter streaked with blood. Great prostration, difficulty of breathing, &c.	White of egg beaten up in milk or hydrated peroxide of iron (iron rust).
Compounds of copper (for example, verdigris, blue-vitriol).	Rough metallic taste in mouth, thirst, pain in stomach, vomiting and purging. In bad cases, spasms and convulsions.	Eggs beaten up in milk, sugar, or carbonate of soda.
Compounds of lead (for example, sugar of lead).	Similar to above, with coldness of skin, and great prostration. Paralysis, 'drop-wrist.'	Epsom-salts, or dilute sulphuric acid.
Compounds of mercury (for example, calomel, red and white precipitate, &c.)	Same as in compounds of copper.	White of eggs beaten up in milk til the substance vomited becomes transparent. If this be not at hand, wheat flour mixed with soap and water to be given plentifully.

Poisons.	Symptoms.	Antidotes and Treatment.
Lunar caustic (nitrate of silver).	Extreme irritation corroding the parts.	Common salt, followed by mucilaginous drinks, like linseed tea.
Narcotics.		
Opium, as laudanum, morphia, paregoric. Chloral, Chlorodyne, &c.	Giddiness, drowsiness, stupor, stertorous breathing, contracted pupil of eye.	Strong coffee, vinegar, or lemon-juice, given freely after vomiting is induced by an emetic.
Prussic acid (essential oil of almonds).	Instant insensibility, followed by convulsions and death in a few minutes, if dose be large.	Strong coffee should be given instantly, and the patient must smell of camphor or vinegar if possible. Pour cold water on top of head, keep the other parts warm by friction, but at the most very little can be done.
Carbolic acid.	Corrosion of skin of mouth, &c. Delirium, giddiness, insensibility, and coma. Dryness and heat of outer skin.	Epsom-salts, or half-pint of olive-oil.
Narcotico-irritants.		
Alcohol, belladonna, hemlock, foxglove, monkshood, tobacco.	Irritation of throat, gullet, and stomach, followed by giddiness, drowsiness, delirium, stupor, convulsions.	Strong coffee. Use of hot bottle to sides, &c.

170. **General Remarks on Poisonings.**—Poisons for domestic use should be distinctly labelled and kept under lock and key. Whenever drowsiness and stupor supervene, as in the case of taking opium, the patient *must* be kept awake by giving strong coffee, dashing cold water in the face, walking him about in the open air when possible, pricking, pinching, or applying mustard plasters to the soles of the feet, or using a

galvanic battery. Where, however, the face is sunken, and the skin cold and clammy, warm applications and stimulants (provided they can be swallowed) should be made use of, and cold avoided.

Poisoning often occurs from allowing acetate of copper, better known as verdigris, to form on cooking utensils. They should be kept scrupulously clean, and cold broth, &c. should not be allowed to stand in them. Poisoning by lead is very common both from lead-paint and the use of water that has been in contact for some length of time with lead piping or cisterns. It produces paralysis and other terrible effects, and pipes and cisterns should therefore be lined by some harmless material.

171. Animal matter is frequently rendered poisonous by putrefaction and disease. Mussels are frequently an irritant poison, producing an affection known as mussel rash. In these cases, powdered charcoal or strong coffee should be taken. In the case of putrid meat, such as new pork in hot weather, give first diluted vinegar or lemon-juice, followed by strong coffee *without milk*. In any cases of poisoning where the breathing ceases, artificial respiration should be practised, as in drowning; and in the case of poisoning by chloroform, a smart tap or two over the heart—that is, just below the left nipple—will often set it going again. Some poisons produce suffocation, as coal gas, carbonic dioxide, sewer gas, &c. In these cases the patient must be carried into the open air, and artificial respiration be persistently tried for at least half an hour, or till breathing be restored.

BITES.

172. **Bites from Dogs.**—The danger of these proceeds from the fear that the animal may be suffering from rabies, and, consequently, that the much dreaded disease hydrophobia may follow.

If the skin be not broken, there is no danger from the bite; but even a dog licking its master's hand, the skin of which is cracked or sore, may cause the disease in him when it is only in the early stage of the rabies itself.

If the bite has been through cloth, the risk is lessened, as the teeth of the animal would thereby be more or less cleansed of the poisonous saliva.

Unfortunately, there is no known cure for hydrophobia, though several eminent physiologists, notably Pasteur, have propounded remedies which at present need greater experience to prove them successful. The frequent use of strong vapour or Turkish baths is strongly recommended to prevent the poison being carried throughout the circulation. The wound should be well washed in warm water, bleeding should be encouraged at first, and then the edges of the wound should be cauterised by being burnt with a red-hot knitting-needle, or by an application of lunar caustic or carbolic acid. If other animals, such as the cat, be bitten by dogs, they may transmit the disease to human beings, and should therefore be destroyed.

173. **Snake Bites.**—The only venomous snake in this country is the adder, which may be known by its dark brown skin with lozenge-shaped marks down the back. Its poison is not usually strong enough to kill, but very serious inflammations and swollen limbs often result.

The treatment is to squirt into the wound Condy's fluid, sweet oil, or ammonia.

In other lands, venomous snakes, such as the rattle-snake and cobra, cause the death of many persons annually. In the case of a bite, a tight ligature should be bound between the wound and the heart, in order to stop the venous circulation—the arterial flow will do no harm, but will help to wash the venom from the wound, which should be cauterised by having thrust into it the lighted end of a cigar, a red-hot iron, or a live cinder.

174. **Stings** or bites of insects, such as the gnat, bee, wasp, mosquito, are often painful, but seldom have serious results, though erysipelas may supervene, and death ensue if the blood be in a diseased state.

If the stings be numerous, or be inserted in some delicate place, as the eye or throat, the result may be fatal. Mosquito bites, happily almost unknown in England, are particularly powerful and irritating. The application of a little sweet oil or ammonia, or some weak astringent, such as nutgalls, is usually sufficient as a remedy.

Note.—The sting of a wasp, &c. may usually be squeezed out of the skin by placing over it the barrel of a watch-key and pressing it hard upon the part.

APPENDIX.

SYLLABUS OF HYGIENE.

ELEMENTARY STAGE.

1. *Food, Diet, and Cooking.*—Classification and uses of Food Substances: Animal Food, Vegetable Food, Condiments; Diet, requisites for maintenance; Cooking, roasting and boiling; Advantageous preparation of food; Cooking apparatus.
2. *Water and Beverages.*—Different kinds of water, sources of water, good drinking water; Sources of contamination of water and its deleterious effects; Cisterns and wells; Tea, coffee, and cocoa—preparation and effects; Fermented drinks—effects.
3. *Air.*—Amount of air necessary for each person; Movements of air brought about by changes of density; Composition of air; Impurities of air; Deleterious gases.
4. *Removal of Waste and Impurities.*—Principles of ventilation; Natural ventilation; Washing and soap; Removal of parasites; Danger of dirt.
5. *Shelter and Warming.*—Materials of clothing; Sufficiency of clothing for infants and adults.
6. *Local Conditions.*—Soil, and its drainage; Aspect; Elevation—Hill, plain, and valley; Distance from the sea; Influence of surrounding objects; Winds.
7. *Personal Hygiene.*—Habits; exercise, rest, and sleep; cleanliness; attention to the action of the skin and bowels.
8. *Treatment of slight Wounds and Accidents.*—Treatment of cuts, burns, scalds, bleeding, fits, drowning, suffocation, poisoning, bites, and stings.

EXAMINATION PAPER.

1884.

FIRST STAGE, OR ELEMENTARY EXAMINATION.

INSTRUCTIONS.

You are permitted to *attempt* only *eight* questions. You *must attempt* the *first four* questions on the paper; the other four you may select from the remaining questions.

The same value is attached to each question.

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1. Explain in detail why it is necessary to change the air of an inhabited room.
2. What are the uses of food? What are the 'food substances' or 'proximate constituents' of food? Do any foods contain them all?
3. What is the importance of cleansing the skin? What are the results of want of cleanliness?
4. How are soils classified for hygienic purposes? Which are the most healthy soils? Why is it important that the soil under houses should be drained?

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5. Why are young children so susceptible to cold? What rules would you lay down about their clothing?
6. How is meat changed by the process of boiling in water? What rules would you observe in boiling a joint?
7. What are the characteristics of a good drinking water? What effects are ascribed to the drinking of water contaminated by sewage?
8. What is the composition of cocoa? Compare it with coffee as an article of food.
9. What are the causes of natural ventilation? How may ordinary sash windows be used to ventilate rooms properly?
10. Explain the movements of the air at the sea border. Of what importance are those movements?
11. What influence does exercise exert over the muscles, the circulation of the blood, and the nervous system?
12. Describe a method for inducing artificial respiration.

ADDITIONAL QUESTIONS SELECTED FROM THOSE SET BY THE SOCIETY OF ARTS.

1. How much air does each individual require per hour to keep the space in which he is wholesome? How much space does he require? Give your reasons.
2. Describe various ways in which the outer air may be admitted to rooms without draught. How should the foul air be got rid of?
3. Classify the food substances. Discuss the value of gelatin as an article of food.
4. Describe the action of respiration, and the effects produced by it on the blood.
5. In the following cases, what would you do before the arrival of a medical man? (1) A fit; (2) Drinking scalding water.
6. When a person is compelled to live in a town, what are the principal considerations which should direct his choice of a house? Give reasons for same.
7. What is the difference between hard and soft water? How may hard water be made soft?
8. Give a short explanation of what you consider the best way of ventilating a house.
9. If you had reason to doubt the purity of your water supply, what steps would you take to purify it and render it fit for domestic purposes?
10. What is known as to the effects of dampness of soil upon the health of the persons living upon it?
11. What are the usual causes of dampness in a house? How may they be remedied?
12. What diseases are positively known to be either caused or disseminated by the use of impure water?
13. Supposing that you were compelled by circumstances to use suspicious water for drinking purposes, what precautions would you adopt?

THE DEATH-RATE.

We have had occasion several times to refer to the death-rate in the course of this book, and it may be well here to explain what is meant by the term.

The death-rate is the number of deaths per thousand that occur in a year among a given population, for example, that of a parish, town, district, or the country at large. Since 1837, all births marriages, and deaths have been carefully registered, and returns of them are forwarded weekly from all parts of the country, by the registrars to the office of the Registrar-General in London, and by this means the mortality in different localities can easily be compared, as well as the ages at which the deaths occur. These facts, so far as they affect twenty-eight large towns in England, and eight towns in Scotland,* are published weekly in the leading newspapers, and the inhabitants of those places can thus readily ascertain, by examining the tables, whether their locality is healthy or otherwise, whether infectious diseases are prevalent, and so on. In 1872, a further step was taken to promote public health by the appointment of Medical Officers of Health for both town and country districts, for the purpose of sanitary supervision, and of reporting from time to time the state of health in the districts over which they have control to town councils and local boards. For the purpose of comparison, the number of the population must be known, and so every ten years a census of the inhabitants in the British Isles is carefully taken, and the numbers thus arrived at are amended from time to time during the ten years' interval by adding births and subtracting deaths, so as to have the population of towns and districts as nearly accurate as possible on which to reckon vital statistics.†

The general rule for finding the death-rate is, *Multiply the number of deaths for any given week by 52, affix three ciphers, and*

* The number is increased from time to time.

† Thus the population of Leeds, which at the census taken April 1881 was 309,126, is estimated by the Registrar-General to amount, by increase of births over deaths, &c., to 327,324 in the middle of 1884.

divide the number thus obtained by the population in which the deaths occurred; for example, 4 deaths in a week in a population of 8320 $= \frac{4 \times 52 \times 1000}{8320} = \frac{208000}{8320} = 25$, the death-rate.

Besides this general rate, it is usual to publish the death-rate from zymotic diseases, that of infants under one year old, and of persons over 60 years of age.

GLOSSARY

OF

TERMS AS USED IN THIS BOOK.

Acidulous, slightly sour.

Acrolein(e), an acrid principle produced by the destructive distillation of fatty bodies. Its fumes are intolerably hot and suffocating.

Alkali, used in various senses, but properly a name given to one of the caustic bases, soda, potash, lithia, and ammonia.

Alkalinity, the quality which constitutes an alkali.

Alkaloids, substances resembling alkalis, but existing as proximate principles in the vegetable world—for example, theine. Their only property is that of combining directly with acids to form salts.

Alluvial, composed of alluvium—that is, deposits of sand, gravel, and other transported matter.

Alumina, an earth, the characteristic ingredient in clay.

Amœba, an animalcule capable of undergoing many changes of form.

Amyloid, of the nature of starch or sugar.

Anæmic, deficient in blood; bloodless.

Anti-miasmatic, a remedy against infection or deadly exhalations in the air.

Anti-scorbutic, a remedy against the scurvy.

Antiseptic, counteracting putrefaction.

Artesian (from Artois in France), applied to wells where the water, when reached by boring, rises spontaneously from internal pressure.

Asphyxia, suspended animation, particularly from suffocation (whence *asphyxiated*, choked).

Astringent, a substance that has the property of drawing together organic tissue.

Axiom, a self-evident truth.

Calculi, small hard solid concretions formed in the body.
Catarrh, a cold attended with watery eyes, &c.
Caustic (*adj.*), burning, wasting away; (*noun*) a substance that burns away the texture of animal substances.
Cellulose, a substance constituting the cellular tissue of plants.
Cereal, any edible grain.
Chronic (in disease), inveterate, or of long continuance.
Colic, acute pain in the bowels.
Concomitant, that which accompanies.
Constipation, costiveness.
Creosote, an oily colourless liquid obtained by the distillation of wood-tar.
Detergent, cleansing, purging.
Diachylon, a plaster made of an oxide of lead and oil.
Dietetic, relating to food.
Diphtheria, an epidemic disease in which the air-passages become coated with a false membrane.
Disinfectant, anything that destroys the causes of infection.
Disintegrated, separated into its parts, broken down.
Diuretic, that which tends to excite the passing through or discharge of urine.
Dyspepsia, a disturbance of the functions of the stomach, producing loss of appetite, nausea, &c.
Effete, worn out—hence *decaying*.
Effluvia, exhalations perceived by the sense of smell.
Emanations, that which issues from or is given off; bad gases, &c.
Enteric, belonging to the intestines, applied to typhoid fever, which forms little ulcers in them.
Epidemic, a disease affecting many persons at the same time.
Equilibrium, equality of weight or force.
Erysipelas, St Anthony's fire, a febrile disease, accompanied by a diffused inflammation of the skin.
Etchers, men who produce drawings or figures on metal, glass, &c., by the use of acids.
Ether (chemically), a very light volatile inflammable fluid produced by the distillation of alcohol.
Eucalyptus, a genus of trees, mostly natives of Australia, containing a considerable amount of volatile oil.
Flatulence, the state of being affected by an accumulation of gases in the alimentary canal.

Galvanised, applied to iron coated with zinc—a name improperly used, as the coating is usually done without *galvanic* or current electricity.

Generic, pertaining to a genus or kind.

Glycerine, a sweet viscid liquid formed during the saponification of fatty substances.

Granules, little grains—hence *granular*, *granulated*.

Gymnastic, pertaining to athletics.

Gypsum, sulphate of lime, plaster of Paris.

Hemorrhage, a discharge of blood caused by the rupture of blood-vessels.

Idiosyncrasy, a peculiarity of constitution and susceptibility.

Initial (*adj.*), first, original, as applied to force.

Juniper, an evergreen coniferous shrub bearing small purple berries, from which a flavouring matter for gin is obtained.

Laxative, loosening.

Lichen, an order of cellular flowerless plants consisting of scaly expanded fronds.

Ligature, anything that binds; in medicine, a cord for tying the blood-vessels.

Lye, a mixture of ashes and water; used for cleansing.

Malaria, noxious exhalations of marshy districts.

Mildew, a coating of minute fungi found on diseased or decaying substances.

Molecule, one of the minute particles of which matter is composed.

Narcotic, a substance which produces sleep, insensibility, &c.

Nausea, sickness; loathing.

Nitre, saltpetre, nitrate of potash.

Nutrient, any substance which nourishes by promoting growth or repairing waste.

Organism, a structure acting by means of organs.

Osmose, the tendency in fluids to mix. It is more particularly applied to the act of passing through a membrane or intervening porous structure, the more rapid flow from the thinner to the thicker fluid being called *endosmose*, and the opposite, *exosmose*.

Oxidation, the process of converting into an oxide; that is, the combination with substances of a certain portion of oxygen.

Paroxysm, any sudden violent action, convulsion, fit, &c.

Pearl-ash, impure carbonate of potash.

Pericarp, the outside or wall of the fruit.

Permeable, pervious, yielding passage to fluids (especially).

Piquant, stimulating to the tongue and palate.

Proteids, nitrogenous substances; tissue formers.

Plover, lit. the rain-bird, a wading bird which frequents marshy grounds.

Rabies, madness—specially applied to a dog.

Rickets, a disease of children characterised by great debility, supposed to arise from spinal disease and non-deposition of earthy salts in the bony tissues.

Sedentary, sitting.

Silicon, the base of silex or flint.

Specific, special, pertaining to a species.

Spores, a minute grain which serves as a seed to flowerless plants like the fern.

Stertorous, noisy, snoring.

Styptic, checking the flow of blood.

Talc, a mineral occurring in thin flakes of a white or green colour, and having a soapy feel.

Tissue (anatomically), the texture or grouping of the elements of which the body is composed.

Tracheotomy, the operation of cutting the windpipe.

Tuber, an underground fleshy stem or root.

Turbid, muddy, thick, not clear.

Ulcerations, ulcers; swellings discharging pus.

Urea, the characteristic proximate principle of urine.

Vesicle, a small bladder, hence *vesiculated,* filled with vesicles.

Voltaic (from Volta, an Italian), a term applied to current electricity, produced by chemical action.

Vulcanised, combined with sulphur by heat.

Wort, the sweet infusion of malt.

Zymotic, lit. caused by fermentation; applied to those diseases which are caused and spread by germs.

INDEX.

The figures in this Index refer to the *paragraphs*, and not to the *pages* in the book.

THE END.

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